NEUR5850

Typical and Atypical Development

ACTIVITIES GUIDE:

PROMOTING COGNITIVE DEVELOPMENT THROUGH PLAY

Contributing Authors

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Jason Kwasny: Jason Kwasny is the Principal of Palliser Beyond Borders, a K-12 online school. Prior to this role, Jason was an Educational Technology Specialist, a Mathematics teacher, and had aspirations of becoming a geneticist. Jason is interested in assisting students to grow as creators, and not just consumers, of knowledge.

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Bubbles- Sabrina Francom and Korrine McDonald

Bubbles can be set up as a free play activity or structured by giving small challenges while playing. Bubbles are best done outside in an open space that allows for movement.

TIME: 5 – 30 minutes depending on child interest.

MATERIALS

- Bubble solution – store bought or make your own
- Items with holes in them – bubble wands, slotted spoons, colanders, looped strings…
- A container that will hold bubble solution that is large enough to dip your found items in

Make your own bubbles

SUPPLIES
1 tablespoon granulated sugar
2 tablespoons dish soap
1 cup water

DIRECTIONS
Mix all ingredients and stir gently until the sugar is dissolved.
Blow huge bubbles.

PROCEDURE

Dip items in bubble solution to cover holes. When the item is pulled out of the bubble solution a thin layer of liquid should still be visible stretched across the hole. Blow gently on the liquid to form a bubble. You can also wave the item through the air to make a bubble.

LEARNING

Bubble play is fun! It is social and can be exciting or meditative. It also helps build Executive Function Skills.

Inhibitory skills are enlisted as children choose to blow or not blow; remain still or move; spin their body or not. **Shifting ability** comes into play as children choose which bubble tool to use and/or whether to create bubbles or chase/catch/pop them. **Emotional control** (excitement/ frustration) is practiced when controlling motor movements not to spill, controlling breath to make a bubble, or if bubbles burst, don't form, and in the context of competition and turn taking. **Monitoring** is used when players anticipate the trajectory of bubbles, decide where to move their body, and participate in turn taking. Working memory is activated to make bubbles in different ways and realize how wind can help or hinder bubble formation.

CURRICULAR LINKS

Science	Art and Math	Language & Literacy	Social	PE
• Cohesion • Surface tension • Transparent • Dissolve • Solution • Molecules • Senses	• Shapes • Counting • Measuring • Colour spectrum • Beauty	• Vocabulary • Mouth muscles • Visual tracking • Speaking • Listening • Breathing	• Turn taking • Shared attention • Cooperation • Emotions • Wonderment	• Gross motor & fine motor skills • Hand eye coordination • Proprioception • Agility • Hand dominance • Midline crossing

ADAPTATIONS

<u>Limited mobility</u>

- Supply a personal bubble solution and wand to the person where they sit.
- A friend could hold the bubble wand or item for the person to be able to blow their bubble
- A bubble fan or bubble gun can be used

<u>Sensory Awareness</u>

- Provide paper towels for people that don't like wet hands
- Have gloves available
- Try different scented soaps
- Play music

<u>Challenges to extend play</u>

Can you catch a bubble?
How big of a bubble can you make?
Can you blow more bubbles than me?
Can you make your bubbles go low to the ground, or high over an object?

LINKS TO MORE BUBBLE EXPERIENCES

Bubble Towers https://happyhooligans.ca/bubble-blowing-activity-building-bubble-towers/

Dry Ice Bubbles https://www.kiwico.com/diy/stem/crazy-chemistry/dry-ice-bubbles

Bubble Painting https://tinkerlab.com/bubble-paint-recipe/

References

Emmer, M. (2015). Colours and Soap Bubbles. *Cultura E Scienza Del Colore - Color Culture and Science, 3*, 28–32. https://jcolore.gruppodelcolore.it/ojs/index.php/CCSJ/article/view/15.03.04

Gross, C. M. (2012). Science concepts young children learn through water play. *Dimensions of Early Childhood, 40*(2), 3-12. https://www.hookedonscience.org/files/Science_Concepts_Young_Children_Learn_Through_Water_Play_Carol_M_Gross.pdf

How bubbles support gross motor skills. (2020, March 24). Baby Sparks. Retrieved July, 17, 2022 from https://babysparks.com/2020/03/24/how-bubbles-support-gross-motor-skills/

Prath, S. (2019). Helping students with executive functions – What is our role as SLPs? *The ASHA Leader, 24*(9), 36 – 39. https://leader.pubs.asha.org/doi/10.1044/leader.SCM.24092019.36

Urszula. (2019). *10 Developmental benefits of playing with bubbles.* SensoryLifestyle https://www.sensorylifestyle.com/toddler-activities/10-developmental-benefits-of-playing-with-bubbles/

Na'h e'tse'ah: Dene Hand Game (Treaty 8 Territory) Toni Craig and Stuart Nish A Dene Tha' version of the Blackfoot Game "Rock in Fist" (Treaty 7 Territory) Time: ~10 minutes	
Background	Hand Games is a traditional game of the Dene People. Historically, it was played between groups of people (as many as 30), often during times of trade, and for the purpose of entertainment and gambling. Today, it is a popular sport in the Arctic Winter Games and cultural events. Given the vast diversity of the Dene culture, which ranges from Northern Alberta and BC, into the Northwest Territories and Yukon, there are many different variations of this game, however, the basic rules remain the same.

Materials	→ Variety of stones or other objects (small enough to be hidden in a hand).
	  ○ Only 1 stone will be used but students will be provided with a choice of stone.
	→ Up to 12 Sticks (between 12-18 inches)
	  ○ Only 3 sticks will be used for this game, but extra sticks may be necessary for extensions.
	→ Blankets, coats (or something similar).
	→ Drummers and singers (if available), or recorded music.

Instructions	Although intended as a group game/sport made of teams of 4-8 people (or more), the following instructions are focused on individual (one on one) play. → Begin the game by sitting cross legged or kneeling across from your opponent(s) with a blanket on the ground between you and sticks on the blanket, to the side. → Choose who will hide first.

	→ The "hider" will: o choose a stone o put their hands below the blanket and hide the stone in one hand or the other. o Remove their hands and perform any variety of hand movements, while chanting, to distract their opponent. → Upon a cue from the "guesser" (a clap, shout, loud noise, blowing a whistle, etc.) the "hider" will hold their hands in front of them, over the blanket. Clearly indicating a right and a left hand. → The "guesser" will then choose the hand that the "hider" must open and expose by pointing at the hand or in the direction of the hand they think the object is hidden. → The hider then opens the hand indicated. → If the "guesser" selects the hand **without a rock**, the "hider" will get a stick and continue as the "hider" for the next round. The "guesser" will need to guess again. (If they guess wrong 3 times in a row, they lose). The "hider" must also reveal the other hand to ensure the rock is in that hand (and has not been dropped). → If the "guesser" selects the hand **with a rock**, they will become the "hider". o Once the "guesser" has won the remaining stick(s), they will be able to take sticks previously won by the "hider". → The game continues until all sticks are won by one person or team. * Recognizing the diverse sensory, cognitive, and social needs of all students, adaptations can be made quickly and easily. These instructions are at the entry level of complexity. Extension instructions are below. These instructions are more aligned with the complexity, and richness of the game/sport.

Adaptations and Modification	Supports	Extensions
	- No (or slower) movements meant to distract the guesser. - Modelling the play - Teacher keeps score (and distributes the sticks) - Selection of items to hide that consider sensory/motor issues (soft items) - Fewer sticks (shorter game) or no sticks. - A blanket for each person. - The teacher will give a prompt to stop and choose a hand. - Stop the drumming or music when it is time to choose a hand (in the style of musical chairs). - a rhyme or chant (e.g. “Where’s the stone hidden, where’s the stone hidden, where’s the stone hidden, stop!) - No music	-Traditional drumming or music is played continuously. - Increasingly intricate and elaborate gestures and movements. - Students keep score and retrieve their own sticks. - Increase competitiveness by playing for prizes or rewards. - Play in a group of 4-8 people. Rules of play will change with groups. See below: - Each team will select a captain who will be responsible for: 1.Signaling the time for selection. 2. Choosing which hand (left or right) to reveal first. - There will be a stick for each player. - If the opposing captain chooses wrong, you get to hide again and you get a stick. - If the opposing captain chooses correctly, you are out for that round. - This continues until all the sticks have been won by the hiders (in which case it is game over), or the captain eliminates all opposing players (in which case a second round begins with the opposing team becoming the hiders). - the game continues until all sticks have been won by a single team. *In group play it is also common to have specific hand signals used to split groups and specify which person reveals which hand. This is for advanced players only!

Skill Development	Motor Skills	EF Skills
	Gross motor → Core strength: standing to sitting cross legged or kneeling on the ground. → Arm / shoulder mobility: raising hands/arms above head, behind back, forward and laterally Fine Motor → Moving rock from hand to hand → Grasping rocks and sticks → Performing intricate hand movements Tracking → Extraocular muscles to monitor and track hand movements → Head and neck muscles.	Attention and Focus → Monitoring who's turn it is to hide or guess. → Focus on task → Look for clues in body movements or gestures. Working Memory → Remembering the rules of the game. Emotional Control → Coping with frustration Inhibitory Control → Controlling outbursts or adverse reactions to frustration or joy Cognitive Flexibility → Shifting roles (I.e., hider to guesser) Organization → Keeping track of sticks, blankets, stone, etc.

List of Important Terms
Executive Functions: The ability to focus, hold, and work with information in mind, filter distractions, and change tasks (Gibb et al.). **Inhibitory control:** the "ability to control impulses and stop engaging in a behaviour" (Gibb et al.). **Fine motor skills:** "The ability to make movements using the small muscles in our hands and wrists" (Belsky, n.d.). **Gross motor skills:** "involve movements of the large muscles of the arms, legs, and torso" (Belsky, n.d.). **Attention:** The ability to hold and focus on information in mind, while tuning out irrelevant thoughts (Diamond, 2013). **Monitoring: "**Ability to check work and to assess one's own performance; ability to keep track of the effect of one's own behavior on other people" (Gibb et al.). **Working memory:** "Ability to hold information when completing a task, when encoding information, or when generating goals/plans in a sequential manner." (Gibb et al.). **Emotional control:** "Ability to regulate emotional responses appropriately." (Gibb et al.). **Cognitive flexibility:** The ability to switch gears, endure changes to schedule, and approach problems in different ways (Belsky, n.d.). **Organization (of materials):** Ability to put order in work, play, and storage spaces (e.g., rocks, sticks, and blanket) (Gibb et al.).

Relevant Areas of the Brain Activated During Game Play

Prefrontal cortex and the parietal lobe: In charge of planning behaviour and executive functions. Dorsolateral prefrontal cortex and areas of the parietal cortex are involved in working memory. Inhibitory control areas include the orbitofrontal, mesial frontal, and anterior cingulate areas of the frontal lobe, along with the caudate, and the parietal cortex. Cognitive flexibility can involve areas such as dorsolateral prefrontal cortex, left posterior parietal cortex, and the left premotor cortex (Gibb & Kolb, 2017).

Premotor cortex: After receiving instructions from the prefrontal cortex, the premotor cortex sends signals coordinating movements of many body parts (Kolb et al., 2019).

Primary Motor Cortex: Produces focal, skilled movements involving our hands, arms, and mouth (Kolb et al., 2019).

Reward Systems: Brain areas involved with rewards include the prefrontal cortex, anterior cingulate cortex, insula, nucleus accumbens, ventral pallidum, amygdala, and striatum (Kolb et al., 2019).

The Limbic System: Brain areas involved in memory and regulating emotional and behavioural responses include the hippocampus (episodic memory), amygdala (emotions), cingulate gyrus (linking emotion, behaviour, and the autonomic nervous system), hypothalamus (response to arousal) and, basal ganglia (regulate voluntary movements, including eye movements) (Kolb, et al., 2019).

References

Dene Games

Na'h e'tse'ah: Dene Hand Games

Belsky, Gail. (n.d.) *What are Fine Motor Skills?* Understood. https://www.understood.org/en/articles/all-about-fine-motor-skills

Belsky, Gail (n.d.) *Trouble with flexible thinking: Why some kids only see things one way.* Understood https://www.understood.org/en/articles/flexible-thinking-what-you-need-to-know?_sp=f939cab5-593a-4390-827b-ba0bf0d69060.1658004561193

Belsky, Gail. (n.d.) *What are Gross Motor Skills?* Understood. https://www.understood.org/en/articles/all-about-gross-motor-skills

Diamond A. (2013). Executive functions. Annual review of psychology, 64, 135–168. https://doi.org/10.1146/annurev-psych-113011-143750

Gibb, R., & Kolb, B. (Eds.). (2017). The neurobiology of brain and behavioral development. Academic Press.

Gibb, R., Piquette, N., Gonzalez, C. Building brains and future: Enhanced curriculum. University of Lethbridge.

Kolb, B., Whishaw, I. Q., & Teskey, G. C. (2019). An introduction to brain and behavior (p. 608). New York: Worth.

Inclusive Play Carnival: Bailey Sisson and Tessa Janzen

Game:	**The Blind Artist**
Overview:	Participants complete this task with a partner. One partner will be the "speaker" and one will be the "artist". The speaker will provide verbal directions for the artist to complete a drawing. This task allows participants to practice oral language and listening skills, fine motor skills, as well as executive function skills. The goal is for the artist to create a drawing that follows the verbal directions of the speaker.
Duration:	5-15 minutes (depends on complexity of image chosen and age/capability of participants)
Materials:	• Table/writing surface/easel, chairs if necessary • Art supplies (could use pencils, crayons, markers, pencil crayons, etc.) • Blank paper • Privacy folder/barrier or optional blindfold • Model images (easy, medium, difficult)
Instructions:	1. Participants will be grouped into pairs – participants will determine who will act as the "speaker" and who will act as the "artist" 2. The speaker and artist will decide together whether they will use an easy, medium, or challenging model image 3. The speaker will select a model image from the options available 4. The artist is behind the privacy barrier or blindfolded and cannot see the model image that the speaker has selected 5. The speaker will verbally describe the model image to the artist 6. The artist will use the directions of the speaker in order to recreate the model image 7. The activity ends when the artist and speaker confirm completion 8. The artist's image is compared to the model image – suggested debriefing questions are provided below
Roles:	**The Speaker** – The role of the speaker is to select a model image for the artist to replicate. The speaker will ***verbally describe*** the model image to the artist. **The Artist** – The role of the artist is to ***listen*** to the directions of the speaker in order to ***draw*** the model image.
Differentiation:	• As one option, the speaker is allowed to correct the artists image ("erase the circle and move it to the right"). Alternatively, the speaker must resist making corrections to the artist. • Model images are separated into different levels of difficulty (easy, medium, hard) – *see appendix A*

	• Optionally, participants are provided with a list of descriptive terms to guide their conversation – *see appendix B*
Modifications/ Extensions Requiring Additional Materials:	If a participant does not have developed fine motor skills, they can use a collection of physical shapes on a page. The Speaker will ask the Artist to move a shape to a certain space on the page (eg. "Move the yellow circle to the top right of the page"; "Place the small blue rectangle at the left corner of the green square"; etc.) Completion of the steps will create a simplistic image. – *see appendix C* Participants may choose to use a different medium to create their art. For example, they may use clay or playdough to replicate a 3D structure. Model structures could include dolls, chess pieces, household objects, etc.
Example Debriefing Questions:	• What is the same between the artist's drawing and the model image? • What is different between the artist's drawing and the model image? • Could the speaker have used different terms to describe the model image? • What was challenging when drawing and not being able to see the model image? • What was challenging when describing the model image and not being able to correct the artist?
Skill Development:	Language Development & Communication Skills: • Oral language, including social language • Active listening • Verbal and non-verbal responses Executive Function: • Response inhibition • Emotional control • Working memory • Cognitive flexibility • Self-monitoring • Task initiation Social Skills: • Cooperation • Following a leader • Making mistakes and accepting corrections • Giving constructive feedback

	Motor Skills: • Fine motor skills • Visual perceptual skills • Visual spatial skills
Other Curriculum Applications:	Math: coordinate planes, translations, slides, measurement

Connections to Neuroscience:

Skill:	**Use of Skill in Activity:**	**Neuroscience Connections:**
Oral Language	Speaker will verbally communicate instructions	• Wernicke's area (language comprehension) • Broca's area (speech production – activation of motor processes) • Arcuate fasciculus (connecting Wernicke's & Broca's areas)
Active Listening	Artist listens to instructions to create drawing	• Wernicke's area (language comprehension) • Frontal lobe (focused attention)
Verbal & Non-Verbal Response	Speaker and Artist can use words, eye contact, gestures, etc. to ensure they are on task with each other	• Prefrontal cortex (interpreting cues)
Response Inhibition	Artist must wait for instructions from Speaker before drawing Speaker must wait for Artist to draw after each instructional step	• Prefrontal cortex – orbitofrontal, mesial frontal, anterior cingulate • Caudate nucleus (selective inhibition)
Emotional Control	Speaker and Artist may experience frustration with the task and can practice emotional control and management	• Ventromedial regions of prefrontal cortex (involved in "hot" EF) • Orbitofrontal cortex (strong connections to amygdala and other parts of the limbic system)
Working Memory	Artist must hold instructions in their brain to remember what to draw	• Dorsolateral prefrontal cortex • Regions of parietal cortex
Cognitive Flexibility	Artist must adjust their thinking as new and different instructions are given by the Speaker	• Lateral prefrontal regions • Angular cingulate

Self-Monitoring	Speaker and Artist both need to be aware of their participation in the activity	• Prefrontal cortex (planning/thinking/etc.) • Amygdala (emotional regulation) • Striatum (motor control)
Task Initiation	Speaker must select an image and determine how to begin their description Artist must begin drawing, despite a potentially unclear description from the Speaker	• Prefrontal cortex (decision making)
Cooperation	Speaker and Artist work together to communicate Only by working together will the goal of the task be achieved	• Nucleus accumbens, the caudate nucleus, ventromedial frontal/orbitofrontal cortex, and rostral anterior cingulate cortex (brain areas that have been linked with reward processing)
Following a Leader	Artist must follow the direction of the Speaker	• Medial prefrontal cortex, posterior cingulate cortex, temporo-parietal junction, posterior superior temporal sulcus
Making Mistakes and Accepting Correction	Artist may misunderstand instructions and draw something incorrectly Speaker may give instructions incorrectly	• Amygdala and prefrontal cortex (involved in risk taking - being willing to try; also involved in emotion regulation)
Motor Skills	Artist must hold and manipulate writing utensils provided in order to draw the image	• Sensorimotor cortex • Prefrontal cortex (planning) • Premotor cortex (sequencing) • Motor cortex (executes action) • Striatum • Cerebellum (coordinating movement)

References

Chauvigné, L. A., & Brown, S. (2018). Role-specific brain activations in leaders and followers during joint action. *Frontiers in Human Neuroscience*, *12*. https://doi.org/10.3389/fnhum.2018.00401

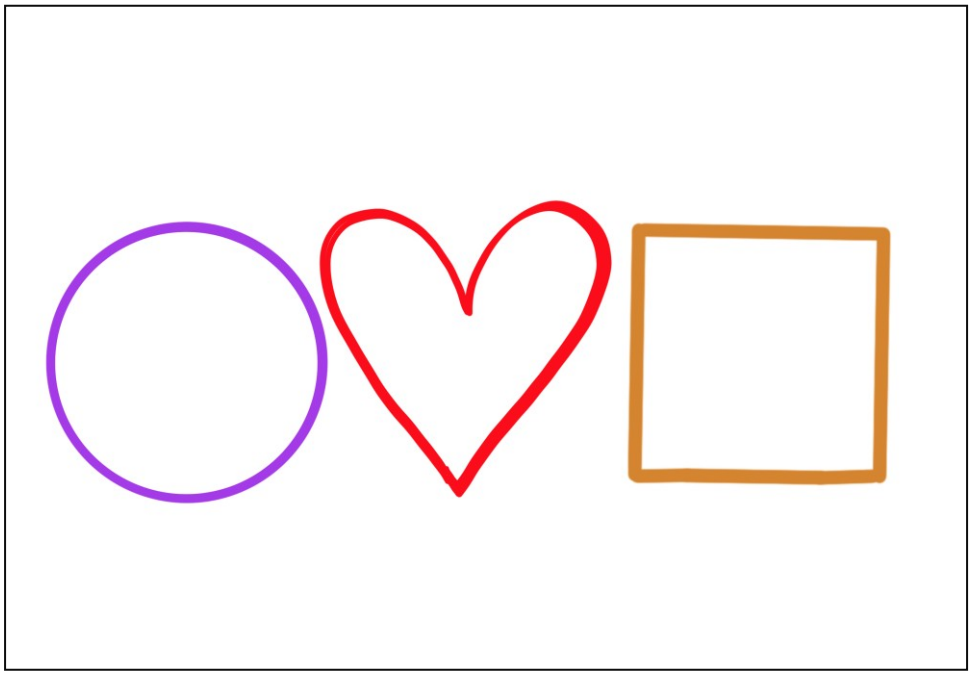
Gibb, R., & Kolb, B. (Eds.). (2018). *The Neurobiology of Brain and Behavioural Development*. Academic Press.

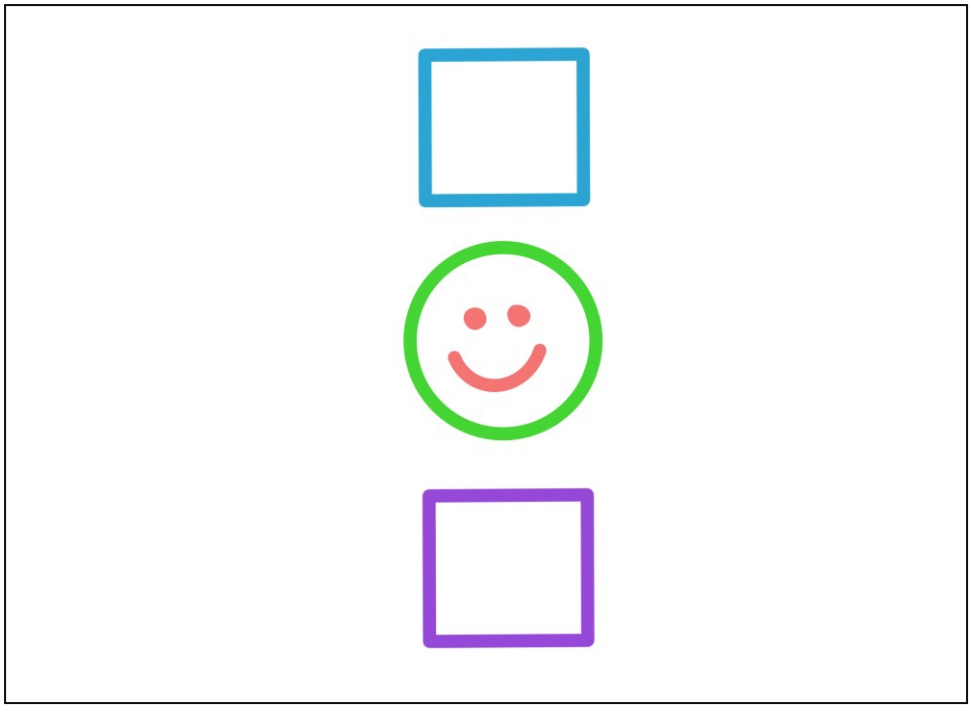
Kolb, B., Whishaw, I. Q., & Teskey, G. C. (2019). *An introduction to brain and behavior*. New York, NY: Worth.

Schmidt, C. C., Timpert, D. C., Arend, I., Vossel, S., Fink, G. R., Henik, A., Weiss, P. H. (2020). Control of response interference: caudate nucleus contributes to selective inhibition. *Scientific Reports, 10*(1), 1-15. DOI: 10.1038/s41598-020-77744-1.

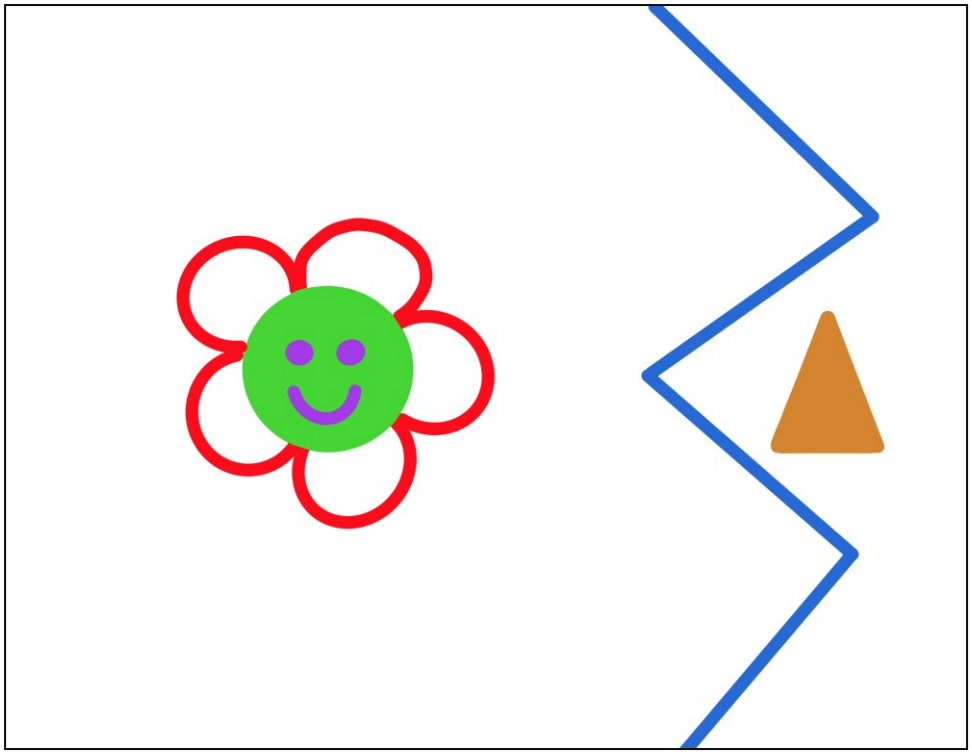
Appendix A: Differentiated Model Images

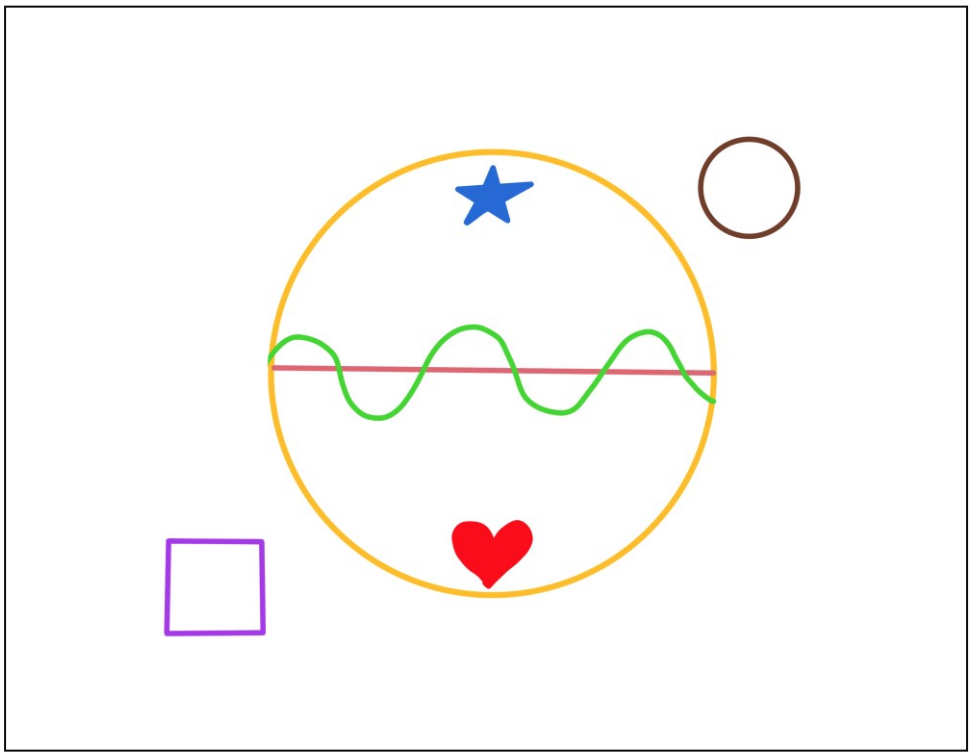
Easy Model Images



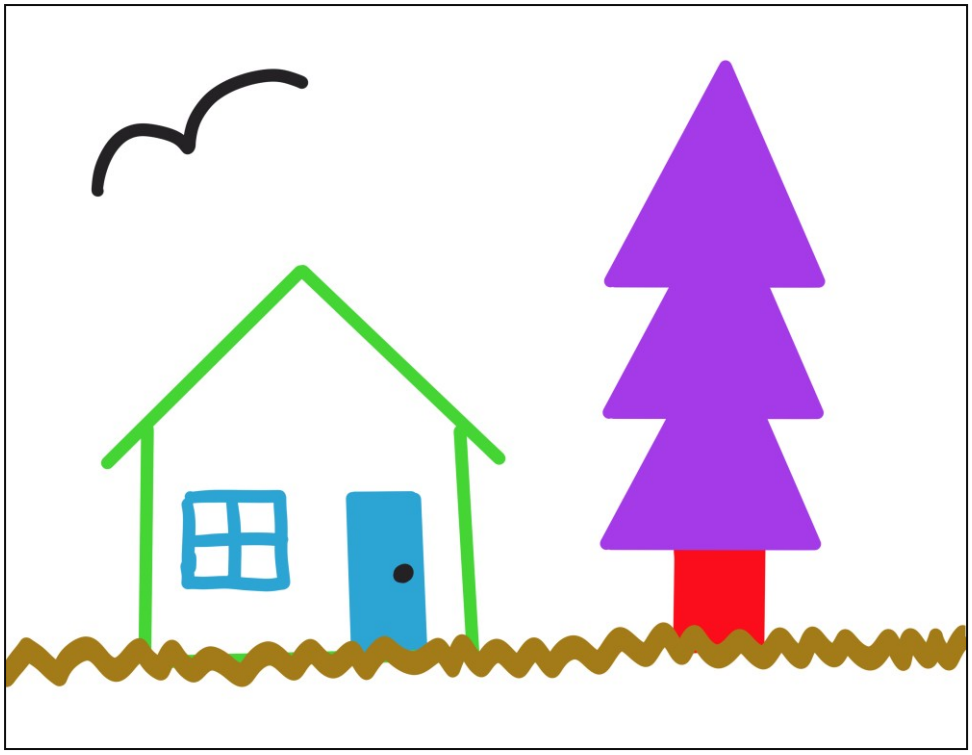


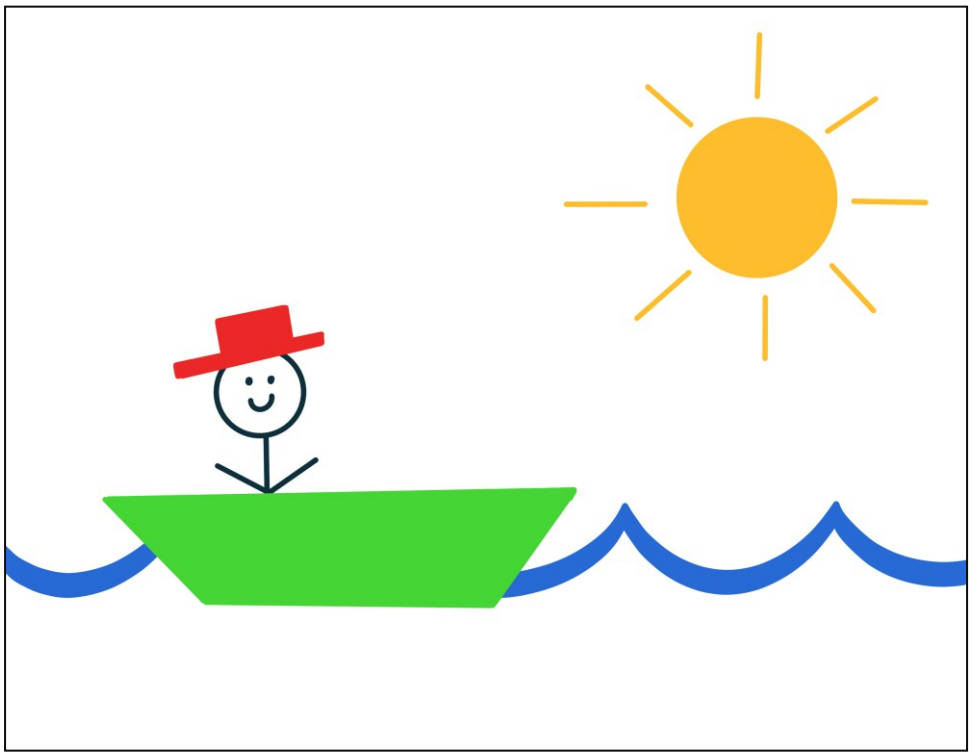
Medium Model Images



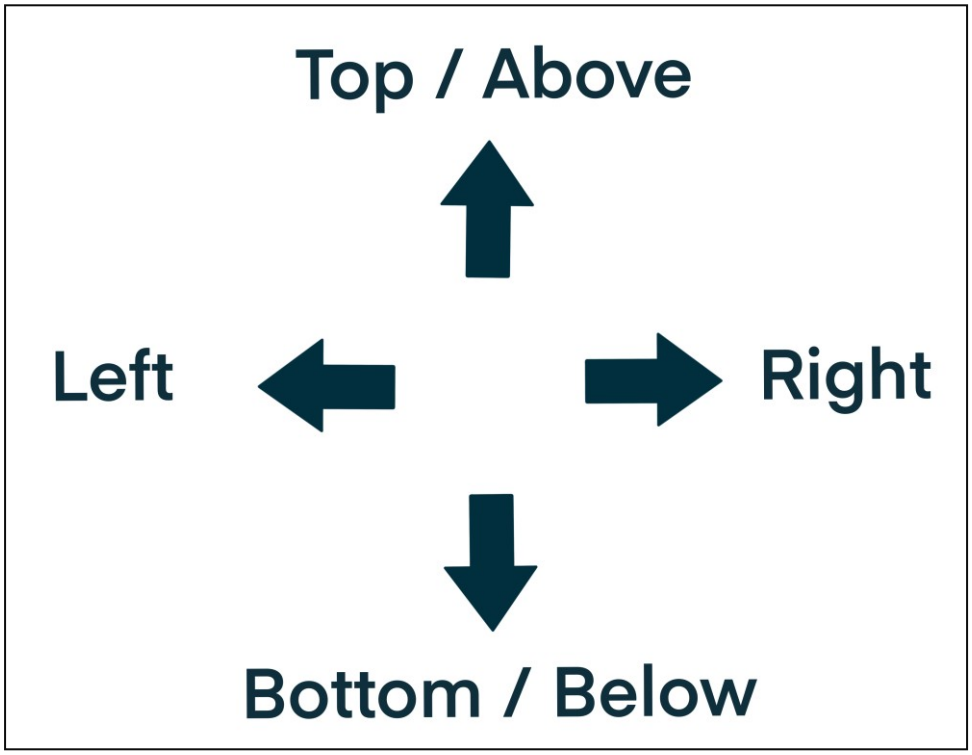


Challenging Model Images

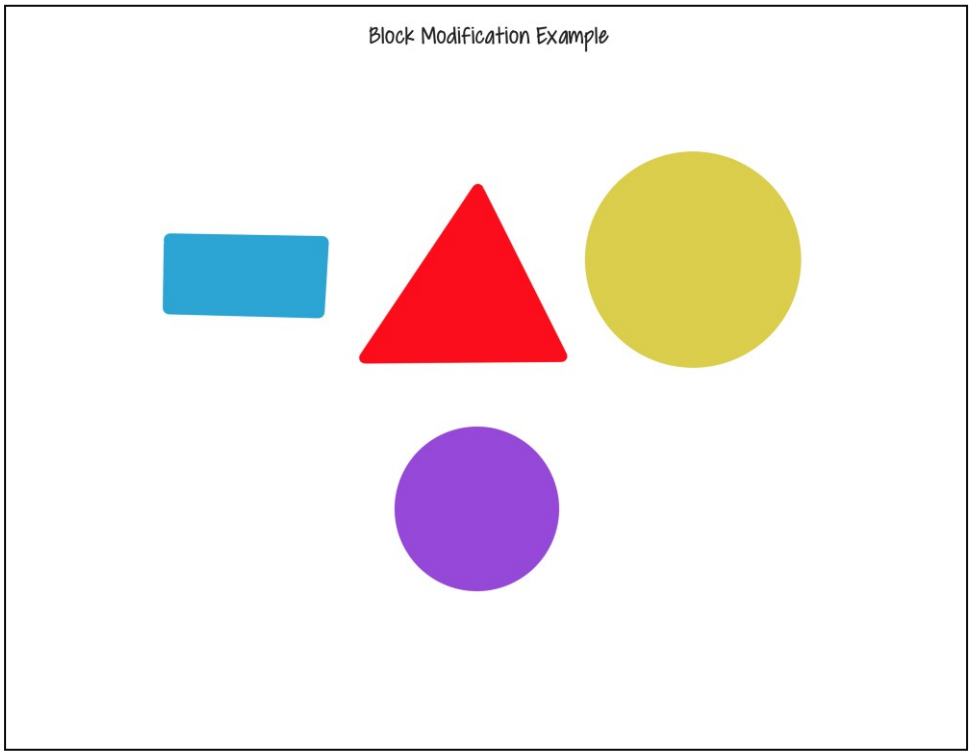




Appendix B: Descriptive Term Anchor Chart

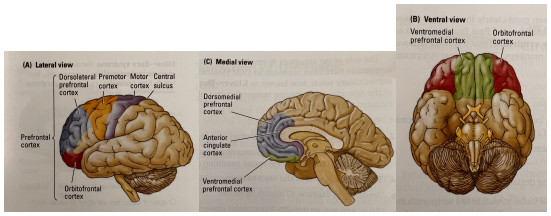
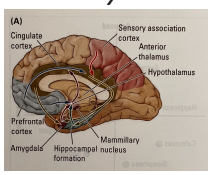
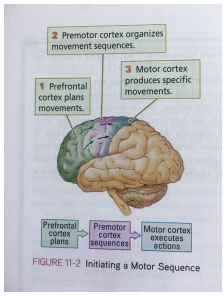


Appendix C: Alternate Block Activity



Name:	***Brain Flakes***
Overview:	***What are Brain Flakes?*** ● Small interlocking plastic discs that can be used to bring a student's imagination to life through creation and building! 
Duration:	The time spent on this activity can be adapted to the needs of the students or teacher; time can be limited and guided or open for larger periods of time.
Materials Needed:	● Brain Flakes (Amazon link): https://www.amazon.ca/VIAHART-Interlocking-Educational-Alternative-Materials/dp/B00N7CD4BK/ref=sr_1_2?crid=15PIEDA88U03S&keywords=brain+flakes&qid=1658335702&sprefix=brain+flakes%2Caps%2C162&sr=8-2 ● Templates (optional - for guided play) ● Bubble Flakes (optional - for differentiation)
Instructions:	***How to use Brain Flakes:*** ● Interlock the discs by sliding them ● You can follow a template to create a specific design (simple or complex), or free play to create a design of their own! ● Brain Flakes can be played individually or with peers. ● We created three different entry points which differ in complexity. Children can begin in any grouping they feel comfortable with! 

Differentiation:	***Entry Points - Adaptive Play Modes:*** ● Bubble Flakes Free Play (Larger brain flakes - easiest to handle and manipulate) ● Brain Flakes Level 1 (Follows a template and instruction guide to create simple designs) ● Brain Flakes Level 2 (Follows a template and instruction guide to create more complex designs) ● Brain Flakes Free Play (Create and build your own design using your imagination)
Skill Development:	***Overview of Skills:*** **Executive Function** ● *Working Memory* ○ Following instructions ○ Planning and organizing materials ○ Attention ● *Cognitive Flexibility* ○ Choosing entry points ○ Planning and organizing materials ○ Adapting designs ● *Behavioral Inhibition* ○ Self-regulation ○ Emotional control ○ Communication and collaboration **Other** ● Dexterity, tactile/fine motor function ● Monitoring and evaluating progress ● Imaginative skills ● Spatial awareness of 2D to 3D ● Visual perception and discrimination ● Teamwork (if working with peers)

Brain Activation:	***Where in the brain does this activity activate?*** *Prefrontal Cortex: executive function*  *Limbic System: emotional regulation*  *Prefrontal & Motor Cortex: performing motor sequences* 
Important Terms:	***Executive Function:*** ● the processes "that underlie the regulation of thought, emotion, and action" (Gibb & Kolb, 2018, pg. 291). The 3 main processes are **working memory**, **inhibitory control**, and **cognitive flexibility**. ***Cognitive Flexibility:*** ● "refers to the ability to shift attention between task sets, attributes of stimulus, responses, perspectives, or strategies" (Gibb & Kolb, 2018, p. 299). ***Working Memory:*** ● "refers to the manipulation of information in the mind" (Gibb & Kolb, 2018, p. 294). This is used for problem solving, task planning and initiation. ***Inhibitory Control:*** ● "refers to the suppression of attention and other responses to particular stimuli" (Gibb & Kolb, 2018, p. 297). This is used in tasks that require resisting external temptations or distractions, attention switching tasks, and controlling of

	behavior. ***Prefrontal Cortex:*** ● The frontal region of the cortex. This brain area is largely responsible for executive function, behavioral selection. "The frontal lobes act much like a composer, but instead of selecting notes and instruments, they selec our actions." (Kolb et al., 2019, p. 427).
Additional Activities:	***Possible activities/ use for Brain Flakes:*** ● *Literacy*: phonemes, word compounds (https://www.instagram.com/reel/CgLMcMtgUFW/?igshid=YmMyMTA2M2Y=) ● *Numeracy*: patterning, 2D/3D nets, fractions, ratios, non-standard measurement, grouping, sorting and explaining sorting/pattern rules ● *Science*: molecule models (high school science), building structures (grade 7 science) ● *Social-emotional:* communication, co-regulation, self-regulation, brain breaks ● *STEM*: makerspace ● *Organization, tracking and communication:* "Watch-Follow-Do" games, mimicking patterns
Resources:	***Brain Flakes Folder:*** (including powerpoint presentation, instructions, templates, entry point cards etc) https://drive.google.com/drive/folders/16QLUjjiUweBJVVn8dDzNpSpaFVlsX7KC?usp=sharing ***Amazon link to Brain Flakes:*** https://www.amazon.ca/VIAHART-Interlocking-Educational-Alternative-Materials/dp/B00N7CD4BK/ref=sr_1_2?crid=15PIEDA88U03S&keywords=brain+flakes&qid=1658335702&sprefix=brain+flakes%2Caps%2C162&sr=8-2 ***Brain Flakes Website:*** https://brainflakes.com/ ***Brain Flakes Videos:*** https://brainflakes.com/pages/videos

Hands and Feet Hopscotch- Jenn Thomsen

Overview:

Research has shown that play promotes healthy child development (Yogman et al., 2018). Its many benefits include developing social-emotional, cognitive, language, locomotor, and **self-regulation** skills. Play can also help to reduce stress and strengthen relationships.

Play can positively affect brain structures and functioning. Areas of the **pre-frontal cortex** known to be important for long-term memory, social learning, sensory, motor, and emotional behaviour are stimulated during play supporting the survival of existing **neurons** and encouraging the growth and differentiation of new neurons and **synapses** (Cozolino, 2013; Yogman et al., 2018). **Dopamine**, **endorphins**, and **serotonin** are also activated, promoting feelings of well-being, social connectivity, and a sense of accomplishment (Cozolino, 2013)

Hopscotch is a game that has been played for many centuries throughout many cultures (Wikipedia, 2022). In this variation, *Hands and Feet Hopscotch,* players (participants) will have the opportunity to practice and develop **executive function**, **early literacy**, gross motor, and social skills. Additionally, the multiple ways in which this hopscotch game can be modified assists caregivers (facilitators) in appropriately **scaffolding** the play within the child's zone of proximal development to promote learning and skill development (Yogman et al., 2018).

The physical nature of Hopscotch encourages the development of spatial and body awareness skills (Cozolino, 2013). These skills are organized in the **parietal lobes**, which are also responsible for creating internal representations of the actions of others, allowing on-lookers to learn from others and "mirror" their actions (Cozolino, 2013).

As players prepare for their turn, their pre-frontal cortex will be engaged in the planning and goal setting for their attempts. During each turn, players will be engaging their pre-frontal cortex for executive function and social skills, the **occipitotemporal** region for early literacy skills (Paterson, 2015), and the parietal lobes and **cerebellum** for the planning and execution of their movements.

Hopscotch is traditionally played outdoors which also improves mood (Clements, 2004). This version, however, can easily be taken inside, and with the addition of some joyful music, can also increase endorphins further fostering a positive and playful brain-developing experience!

Terms:

- **cerebellum:** large structure at the base and back of the brain specialized for learning and coordinating movements (Kolb et al., 2019)
- **dopamine:** a neurotransmitter involved in coordinating movement, attention, learning, and reinforcing behaviours (Kolb et al., 2019)
- **early literacy**: skills and strategies that must be developed before children begin to read
- **endorphins**: hormones released in response to pain, stress, or pleasure (Pinel & Edwards, 2008)
- **executive function:** is an umbrella term used to describe a variety of processes supported by the prefrontal cortex including working memory, decision-making, planning and organization, and self-regulation (Gibb & Kolb, 2018)
- **neurons**: specialized nerve cells engaged in information processing (Kolb et al., 2019)
- **occipitotemporal region**: the regions of the brain along the lower sides spanning around the lower back
- **parietal lobes**: part of the brain that directs movements toward a goal or to perform a task, such as grasping an object (Kolb et al., 2019)
- **prefrontal cortex:** large area of the cortex that plays a role in emotion and social behaviour (Pinel & Edwards, 2008)
- **scaffold**: providing an amount of support to assist a child in completing a task that is just beyond their ability
- **self-regulation:** the ability to manage one's own emotions, thoughts, and behaviours
- **serotonin:** a neurotransmitter that helps to regulate mood and aggression, appetite and arousal, perception of pain, and respiration (Kolb et al., 2019)
- **synapses**: space between the ends of two neurons where information is transferred (Kolb et al., 2019)

Time:

This activity can be done in as little as 5 minutes but can continue for as long as desired!

Materials:

Hands and feet symbols (printed), set-up ideas at varying levels of difficulty, music, painter's tape (if doing the activity indoors on the floor with paper)

Activity Description:

The facilitator will set up the hands and feet symbols on the ground (preferably on a flat surface like a sidewalk or path) according to the developmental level of the participating children (see attached for variations). The facilitator will explain that the children must start at one end of the hopscotch and follow the visual symbols as they progress to the other end. If the participant makes a mistake and uses the wrong body part on any of the symbols, the child must stop and return to the beginning (if there are multiple players, the child will go to the end of the line while waiting for their turn to come again). The facilitator will encourage the waiting children and onlookers to cheer on the person attempting to complete the hopscotch course. Playing cheerful music in the background will help to reinforce that this activity is NOT a competition but a fun way to challenge oneself.

DIRECTIONS

1. Line up the group behind the start line but allow the line to curve so those waiting can see the course.
2. Explain to the children that their goal is to get from the start to the end of the hopscotch course without making a mistake.
3. Clarify that if they DO make a mistake, that it is OK. The course is supposed to be challenging, making it fun!
4. If the participant makes a mistake, they will be asked to go to the back of the line and can try again once their turn comes up.
5. If all the participants can easily make it through the chosen course, the facilitator should increase the difficulty level.
6. Encourage onlookers/ waiting participants to cheer on the person trying the course.
7. Keep participants moving through the course quickly.
8. Play can continue until time is up or participants are tired.

Variations & Adaptations:

1. see attached ideas for setting up the course with varying levels of difficulty

2. to aid in building confidence, participants can start with the easiest course and can increase the difficulty every time they complete a run

3. to increase engagement, participants can design their own course

4. if the paper on the floor is of concern (frightens a child or is a physical hazard), the course can be created on a sidewalk, tracing the participant's hands and feet

5. for children with mobility concerns (for example, those in a wheelchair), the facilitator, another adult, or another participant can slowly assist the child through the course while the child lifts/ makes a small movement with the appropriate hand or foot associated with the symbol they are on

6. adapting the activity by pairing the visual cues with verbal cues or slowing the tempo may make this activity more accessible for some children

SKILL DEVELOPMENT:

Executive Function:

- Cognitive Flexibility**:** continuously changing which hand and foot to use
- Inhibitory Control**:** controlling the impulse to use the wrong hand and/or foot; stopping after making a mistake; natural tendency to place a hand/foot down to regulate balance
- Working Memory**:** to remember the instructions; encoding the visual symbols
- Monitoring**:** keeping track of performance; checking if hand/feet match the symbols on the ground
- Emotional Self-Regulation**:** regulating emotions if a mistake is made and the participant must return to the beginning; regulating emotions if the participant completes the course; demonstrating good sportsmanship
- Planning/ Organization: setting a personal goal for completing the course or for getting to a specific "step" or level

Early Literacy:

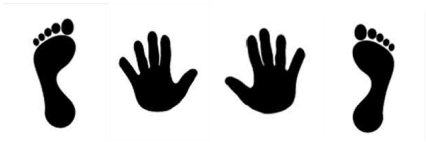
- Supports Early Concepts of Print**:** associating symbols with meaning
- Following a sequence: beginning at the start line and working one "step" at a time towards the end
- Listening Comprehension**:** attending to the directions before and during the game; demonstrating understanding by following through with the directions/ rules
- Fluency: rapid recognition of symbols

Gross Motor Skills:

- Coordination: *hand-eye:* using eyes to direct attention to visual symbols and helping the body understand where it is in relation to the symbols; using hands and/or feet to carry out movement based on visual input; *bilateral:* controlling both sides of the body; using both sides of the body in the more challenging courses; crossing the midline in the most challenging course
- Balance: holding balance while changing hands and/or feet
- Core strength: use of abdominal and back muscles while changing hands and/or feet and while balancing
- Body awareness: the ability to understand where the body is in the course; how far to jump and/or reach
- Motor control: initiating and directing voluntary muscle function and movements from one visual image to the next

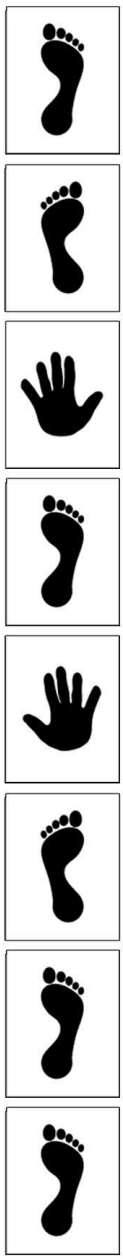
Social Skills:

- Turn-Taking: allowing other participants to try the course
- Concept of sportsmanship: respectfully cheering on others after both their completion of the course or mistakes and subsequent restarts; gracefully celebrating when completing the course; gracefully accepting when a mistake was made and having to restart

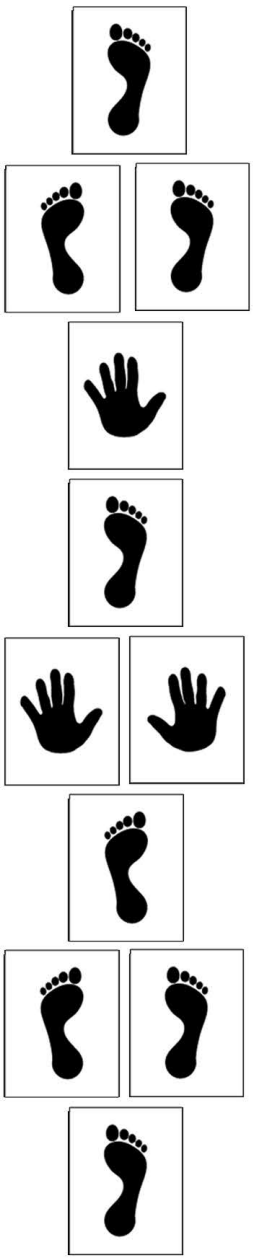


Course Ideas:

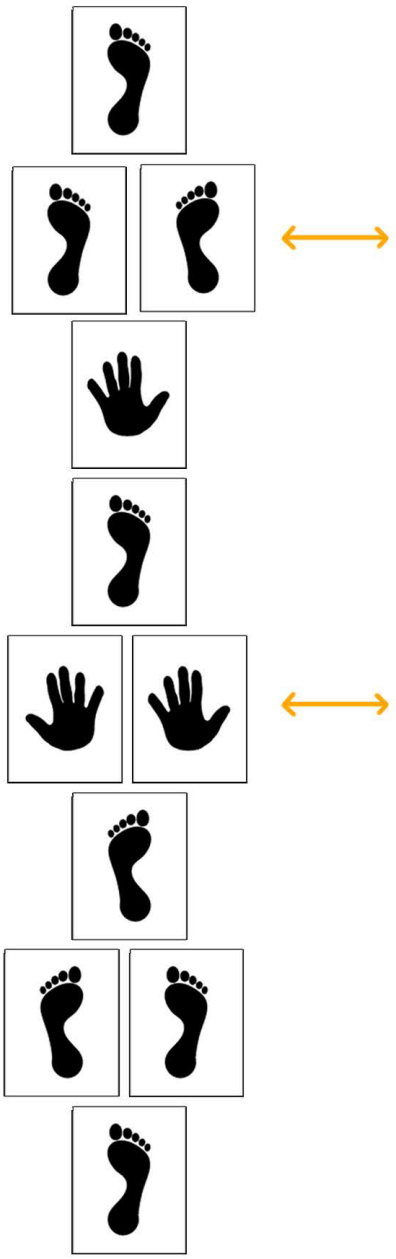
Easy 1



Easy 2



Medium

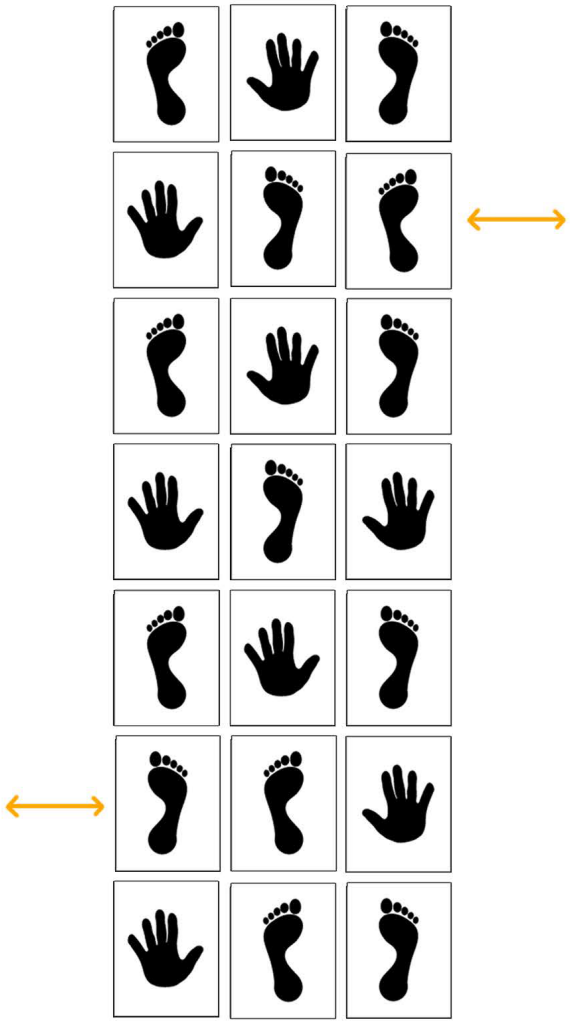


(Psychoscreen, 2022)

Difficult 1

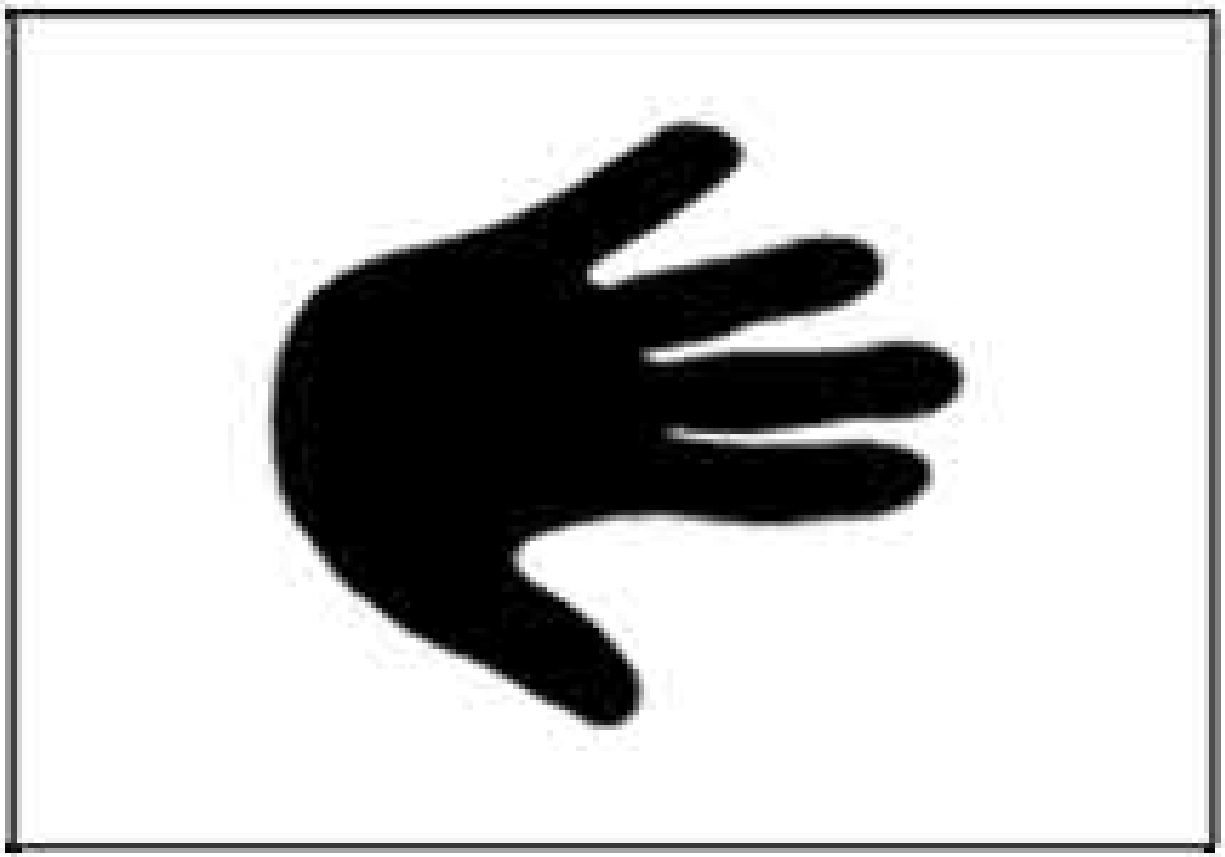
Difficult2

Challenging



(Psychoscreen, 2022)

Cards for Printing:



References

Childsplay Therapy Center. (2014, August 6). *What is bilateral coordination and why is it important?* (https://www.childsplaytherapycenter.com/bilateral-coordination-important/

Clements, R. (2004). An Investigation of the status of outdoor play. *Contemporary Issues in Early Childhood*, *5*(1), 68–80. https://doi.org/10.2304/ciec.2004.5.1.10

Cognifit. *Hand-eye coordination: A fundamental cognitive skill for daily life*. (n.d.). https://www.cognifit.com/science/cognitive-skills/eye-hand-coordination

Gibb, R., Coelho, L., Van Rootselaar, N. A., Halliwell, C., MacKinnon, M., Plomp, I., Gonzalez, C. (2021, December 29). Promoting executive function skills in preschoolers using a play-based program. *Frontiers in Psychology.* https://doi.org/10.3389/fpsyg.2021.720225

Gibb, R., & Kolb, B. (Eds.). (2018). *The neurobiology of brain and behavioural development*. Academic Press.

Hopscotch. (2022, June 23). In *Wikipedia.* https://en.wikipedia.org/wiki/Hopscotch

Kolb, B., Whishaw, I.Q., & Teskey, G. C. (2019). *An introduction to brain and behaviour* (6th ed.). Worth Publishers; Macmillan Learning.

Patterson, S.K. (2015, February 6). *Stanislaus Dehaene's reading in the brain.* Why- and What- Should We Read? https://whyreadwhat.wordpress.com/2015/02/06/review-of-dehaenes-reading-in-the-brain/

Pinel, J.P.J., & Edwards, M. (2008). *A colorful introduction to the anatomy of the human brain.* Pearson Education Inc.

PsychoScreen. (2022). *Hands and feet sensory path*. [Images]. PsychoScreen Etsy Shop. https://www.etsy.com/ca/shop/PsychoScreen?ref=simple-shop-header-name&listing_id=750848540

TREK: Translating Research Evidence and Knowledge. *Motor control and motor learning*. (n.d.). https://exercise.trekeducation.org/motor-learning/

Yogman, M., Garner, A., Hutchinson, J., Hirsh-Pasek, K., Golinkoff, R. M., Baum, R., Gambon, T., Lavin, A., Mattson, G., Wissow, L., Hill, D. L., Ameenuddin, N., Chassiakos, Y. (Linda) R., Cross, C., Boyd, R., Mendelson, R., Moreno, M. A., Radesky, J., Swanson, W. S., … Smith, J. (2018). The power of play: A pediatric role in enhancing development in young children. *Pediatrics*, *142*(3): e20182058. https://doi.org/10.1542/peds.2018-2058

Your Therapy Source. *Body awareness: Why is body awareness important?* (n.d.). https://www.yourtherapysource.com/blog1/2018/09/21/why-is-body-awareness-important-2/

Play Carnival Station: Jason Kwasny & Carmelle Watson Neuro 5850
Summer 2022

Name:	**Developmental Jenga**
Overview:	Developmental Jenga is a fun, interactive, turn-based game that can be played with 2 to 4 players. Players initiate the play by cooperatively building a tower of blocks. For each turn, players utilize their motor planning, executive functioning, and fine motor skills while developing their social-emotional learning. Extensions for Developmental Jenga allow for numerous connections to the curriculum.
Duration:	5 to 15 minutes
Materials:	Set of Jenga Blocks and a flat surface • See differentiation section for alternative versions of Jenga blocks
Instructions:	**Setup** 1. Empty the blocks onto a flat surface. 2. Players place layers of three wooden blocks at right angles to each other. When you finish, you'll have a solid tower. 3. Players determine who goes first (e.g., use dice - highest or lowest starts, youngest player, rock-paper-scissors, etc.). Play passes to the left. **Game Play** 4. On your turn: Carefully remove a block from anywhere below the highest completed story. Then stack the block on top of the tower at right angles to the blocks just below it **Removing and Stacking Blocks** • Remove and stack one block per turn. • As play proceeds and the weight of the tower shifts, some blocks become looser than others and are easier to remove. You can touch other blocks to find a loose one. • While stacking, always complete a 3-block layer before starting a higher one. • Keep removing and stacking blocks until someone topples the tower over.
Skill Development:	Executive Function: • Inhibitory Control • Cognitive Flexibility • Working Memory

	Self-Regulation: • Emotional Control • Self-monitoring Social Emotional Competencies: • Turn taking • Following rules of the game • Following the group plan • Accepting a loss Fine Motor Skills • Motor planning
Scaffolding Supports: *To be offered at a personal level responding to each students' needs.*	• Visuals to pair with verbal prompts to redirect behavior • Visual timers to provide prompts of transitioning • Explicit instruction on how to play game, with modeling and feedback • Use of number line to add numbers • Reader support for decodable words • Adult participation in games provides positive role models for executive functioning, self-regulation, and social-emotional skills Gradually relinquish the use of scaffolding support if student is showing skill development.

Essential Skills and Neuroscience Information:

Executive Functions:

Executive functions (EF) is an umbrella term of skills used for purposeful, goal-directed behavior, which develop from infancy to early adulthood (Zelazo et al., 2016). Executive functions are grouped into three core skills: inhibition, working memory and cognitive flexibility (Center on the Developing Child, 2011; Diamond, 2012; Scalise & Felde, 2017). These essential core skills create the foundation for higher-order EF, such as planning, reasoning, and problem solving (Diamond, 2012; Scalise & Felde, 2017). EF skills are controlled by the prefrontal cortex (PFC), specifically the dorsolateral cortex and the orbitofrontal cortex (Zelazo et al., 2016). EF is facilitated by extensive neuron interconnections between the PFC, the anterior cingulate cortex, which is responsible for inhibition and motivation, and the limbic system, which involves emotions and memory (Center on the Developing Child, 2011; Zelazo et al., 2016). The limbic system consists of the amygdala and the hippocampus; the amygdala triggers emotional responses and determines if sensory information is a threat or not, whereas the hippocampus is involved in memory acquisition, retention, and retrieval (Scalise & Felde, 2017). The coordinating role of the PFC is similar to an air traffic controller, these connections allow for rapid top-down regulation of brain activity (Center on the Developing Child, 2011; Zelazo et al., 2016).

Inhibitory control involves exerting self-control and mediating one's behavior, attention, and emotions (Diamond, 2012). In addition, this skill is used to filter one's thoughts and impulses and to resist temptations and distractions; it enables the ability to pause and think before one acts (Center on the Developing Child, 2011). Inhibition is necessary for sustained, selective and focused attention, prioritization, and goal-oriented action (Center on the Developing Child, 2011; Scalise & Felde, 2017). The areas within the brain that are involved for inhibitory control are the dorsolateral prefrontal cortex, the parietal cortex (processes sensory information), and the anterior cingulate cortex (Gibb & Kolb, 2018).

Cognitive flexibility is thinking about something in multiple ways and shifting brain processing (Scalise & Felde, 2017; Zelazo et al., 2016). Cognitive flexibility is the capacity to adjust to demands, perspectives, or priorities, which enables a person to revise and shift their thinking within different contexts and situations (Center on the Developing Child, 2011). Additionally, cognitive flexibility prevents rigid thinking and promotes learning the exceptions to rules, as well as the ability to approach a problem in different ways and to utilize a variety of strategies (Center on the Developing Child, 2011). The parts of the brain utilized for cognitive flexibility are the dorsolateral prefrontal cortex, the posterior parietal cortex, the premotor cortex (responsible for initiating movement), and the anterior cingulate cortex (Gibb & Kolb, 2018).

Working Memory is the capacity to hold information in mind and mentally manipulate it over short periods of time (Diamond, 2012). Working memory briefly captures and sustains significant sensory information and temporarily recalls memories from long-term memory is essential for effective learning (Scalise & Felde, 2017). Being a transient memory, working memory works together with long-term memory to establish which information is useful, and thus stored into long-term memory for later use (Scalise & Felde, 2017). It is used for comprehending linguistic information that is read or heard,

understanding cause and effect, and mentally organizing information (Diamond, 2012). The areas within the brain involved in working memory are the dorsolateral prefrontal cortex, regions of the parietal cortex, and the occipital cortex (Gibb & Kolb, 2018).

Self-Regulation:

Self-regulation is an internally directed capacity used to respond adaptively to the demands within the environment and is essential for academic success, social adaptation, and positive relationships (Savina, 2014). It involves maintaining optimal levels of emotional, motivational, and cognitive arousal necessary for successful task performance and interactions with others (Savina, 2014). Also, self-regulation is a process of effortful control by which thoughts, feelings, and/or actions are monitored and modulated to achieve goals and initiate socially desirable behaviors (Heatherton, 2011).

The prefrontal cortex is the key brain area for self-regulation; specifically, the three key areas of the prefrontal cortex involved are the ventromedial prefrontal cortex (vMPFC), the dorsolateral prefrontal cortex (DLPFC), and the anterior cingulate cortex (ACC) (Heatherton, 2011). The vMPFC is involved in the ability to regulate social, affective, and appetitive behaviors (Heatherton, 2011). In addition, the vMPFC is strongly interconnected to the limbic system, creating a top-down regulation of the amygdala's function of detecting threat and stimulating the HPA axis to initiate the stress-response (fight, flight, or freeze response) (Heatherton, 2011). The DLPFC is connected to spatial and conceptual reasoning processes that are associated with planning, choice, novelty processing, and language function (Heatherton, 2011). Finally, the ACC is involved with the connection between motor and cognitive systems, which enables the brain to translate intentions into action, monitor for errors, and signal the PFC for additional cognitive control (Heatherton, 2011).

Social Emotional Competencies:

Social-emotional competencies incorporate both intrapersonal and interpersonal skills and involve cognitive, affective, and behavioral skills (CASEL, 2020). According to CASEL (2020), there are five interrelated core components of social-emotional competencies; first, self-awareness, which is the ability to understand one's own thoughts, values and emotions and how they impact behavior. Second, self-management is the capacity to manage one's emotions, thoughts, and actions effectively in a variety of situations. Third, social awareness involves skills to understand the perspective of others, to empathize and show compassion towards others, and to comprehend the group plan (social norms for behavior in a variety of settings). Fourth, relationship skills are the ability to establish and sustain healthy relationships, which includes communicating and listening effectively, problem solving, and negotiating conflicts. Lastly, responsible decision-making, which centers around the abilities to make choices about personal behavior and social interactions (CASEL, 2020). In brief, social competencies are foundational for positive relationships, well-being, and learning. The brain is a social organ and due to its neural plasticity, it can adapt and re-adapt to the changing demands within social interactions (Cozolino, 2013). The prefrontal cortex, specifically the orbital prefrontal cortex and the medial prefrontal cortex, regulates our attachment to others and social cognition (Cozolino, 2013). The prefrontal cortex is able to translate positive or negative values of complex social information, such as facial

expressions, eye contact, and gestures of others, which can shape behaviors (Cozolino, 2013). During enjoyable social interactions, dopamine and oxytocin are released and extended to the prefrontal cortex, amygdala, and anterior cingulate cortex, which regulates our bonding with others and sense of empathy (Cozolino, 2013). In addition, the ventral striatum, the brain's reward center, plays a role in motivating social behavior; the expectation of a social reward stimulates the ventral striatum which activates prosocial behavior (Cozolino, 2013). Lastly, mirror neurons within the prefrontal cortex and parietal cortex are involved in the predicting of behaviors of others and in the planning and execution of our actions, (Cozolino, 2013). Thus, we can learn by watching others to develop social skills.

Fine Motor Skills:

Fine motor skills are the ability to control and make precise movements using the small muscles in the hands and wrists (Kolb et al., 2019). This game requires players to use the pincer grip to hold the block between their thumb and index finger (Kolb et al., 2019). The voluntary movements for fine motor skills are coordinated by several components of the nervous system. The prefrontal cortex plans the behavior by making the decisions on which goal to select for movement and sends the instructions to the premotor cortex (Kolb et al., 2019). Then the premotor cortex plans and produces the movements required of the body parts involved, which passes this information to the primary motor cortex to execute the actions of arms, hands, and fingers by sending messages along the motor neurons (Kolb et al., 2019). In addition, information from the occipital lobe (vision processing) and the parietal lobe (sensory information processing) is being processed and adjustments and corrections are occurring by the basal ganglia and cerebellum (Kolb et al., 2019).

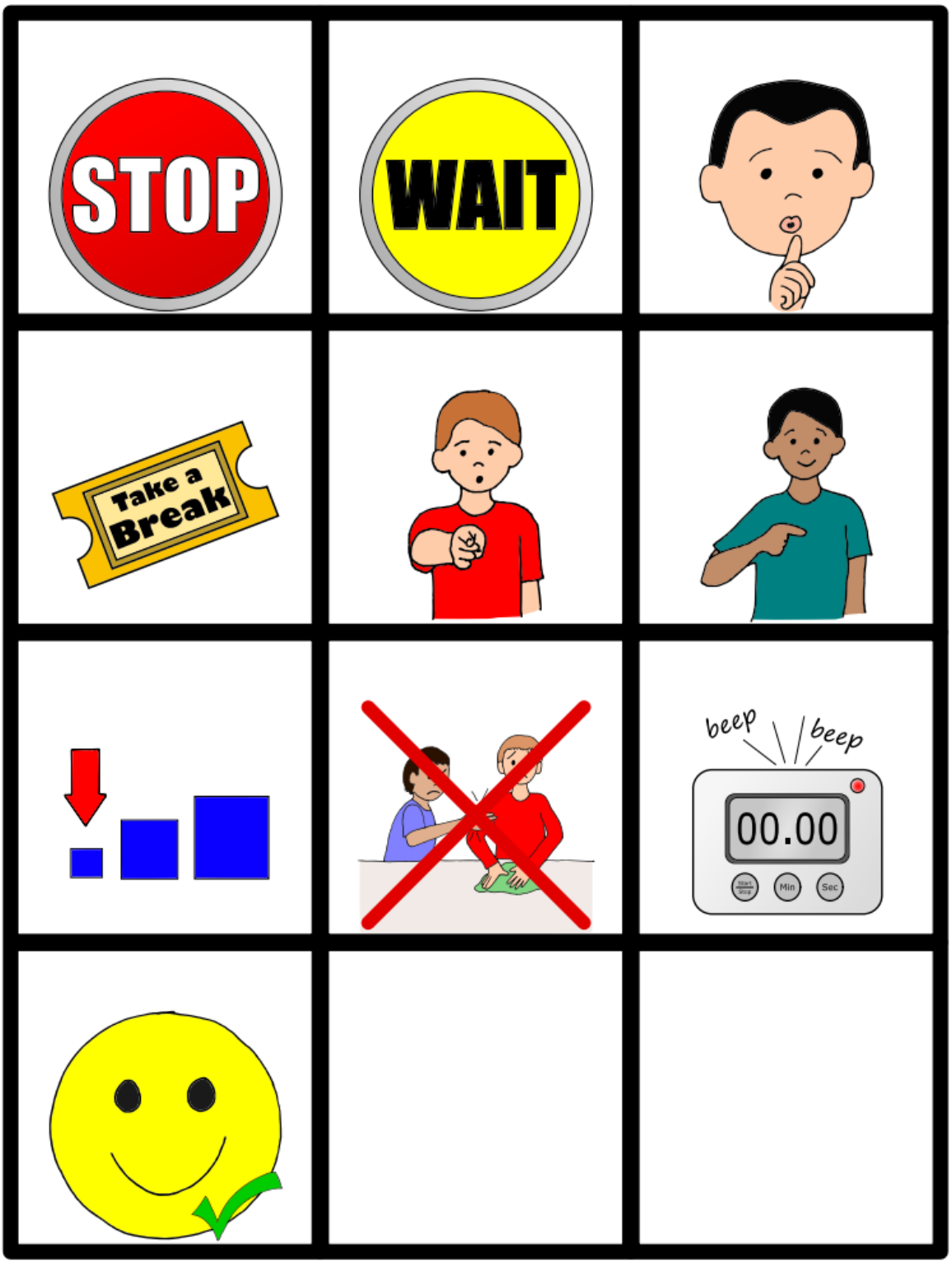
Differentiation			
	Description	Additional skills	Level of difficulty (compared to the original)
Large blocks	Large blocks can be utilized to make the game accessible to students with a delay in fine motor skills that make the smaller blocks difficult to work with.		Easier
Regular sized blocks	Players utilize regular blocks to play the game.	- More precise fine motor skills compared to larger blocks.	Medium (Base line)
Colored blocks and dice	All the blocks are one of three different colors. Instead of selecting any block, students are first required to roll the colored dice and then to remove the block of the color that is rolled. This can also be completed with numbered blocks.	- Cognitive Flexibility	More difficult
Differentiation will be in response to students' skill set and provide multiple entry points for the game			

Extensions *The level of difficulty of Jenga is at the same level but the secondary task increases the difficulty of the game.*		
Numbered blocks*	On each block write a number (0-9) written on it. The first block students select would be held (not returned to the tower). After the second block is selected, students would complete a developmentally appropriate mathematical operation with the numbers before returning a block to the tower. This could further be modified by having students hold several blocks and using the order of operations to create a number sentence that is equivalent to a predetermined number. The numbers could also be used to identify a question from a written list that needs to be answered.	- Curricular connections - Numeracy skills
Literacy Blocks*	Each block can have a letter on it for students to identify the letter name and/or sound. Also, blocks can have decodable words or sight words for students to read.	- Phonological awareness - Sound - symbol association - Decoding skills - Sight word recall
Vocabulary blocks*	Each block would have a word written on it. Depending on developmental level, these could be sight words, decodable	- Curricular connections

	words, curricular vocabulary words, etc. After selecting a block, students would be required to complete a task with the word (e.g., read, define, create a sentence, etc.).	- Literacy skills
Social Emotional Learning (SEL) blocks*	Each block would have an SEL prompt written on it. After selecting a block, students would be required to answer a developmentally appropriate question associated with the situation (e.g., differentiate the size of the problem, differentiate if behaviors are expected or unexpected, match feelings with the Zones of Regulations).	- Awareness of Self - Self-regulation - Social competencies

One Jenga set can be used for multiple customizations (see examples above) by using the different faces of the block for different customizations.

Picture Cards



Picture Cards

Play Carnival Station: Jordan Code and Veronica Doyle
Neuro 5850 Summer 2022

<table>
<tr><td>Name:</td><td colspan="3">Watch, Follow, Do!</td></tr>
<tr><td>Overview:</td><td colspan="3">This game is called “Watch, Follow, Do” and it has the option of being either competitive or collaborative depending on the age, personalities, and other factors of the students playing. It consists of three different stations, each one based on a different sense. The goal of the game is to create and then re-create different types of patterns.</td></tr>
<tr><td>Duration:</td><td colspan="3">5-10 minutes per station</td></tr>
<tr><td>Materials:</td><td colspan="3"><u>Auditory Station:</u>
• Various musical instruments such as drums, maracas, tambourines
• Household items that can create sound such as containers filled with rice, items to bang together, spoons
<u>Visual Station</u>:
• Blocks
• Lego
• Building materials
• Playdoh
• Images of possible building patterns or ideas (included)
• File folders to cover up image/pattern
<u>Kinesthetic Station</u>:
• Space
• Images of possible movements (included)
• File folders to cover up movement pattern card layout</td></tr>
<tr><td rowspan="2">Instructions:</td><td colspan="3">1- For students who wish to play collaboratively, the goal of each station is for the first person to create a pattern. Then the other player repeats/re-creates the pattern and can extend the pattern.
2- For students who wish to play competitively, the first student creates a pattern that must be repeated by the second student. Points are awarded to the student who successfully repats the pattern. Once one student has started a pattern, the other has the opportunity to create a pattern. They can also add an item to the end of the pattern to make it harder and this would create a back-and-forth competition between players.
3- There are three stations that these rules apply to. Students may move in any order through the stations and stay as long as they like at each one (depending on overall group size and timing).</td></tr>
<tr><td><u>Auditory station:</u> Using the provided materials, students must create a sound pattern. Their partner must listen carefully to be able to re-create it.</td><td><u>Visual station:</u> Using the blocks, students must create an image that is then reproduced by the second student. They may either use their imaginations or the suggested ideas.</td><td><u>Kinesthetic station:</u> Using their whole body or parts of their bodies, students create a pattern of movement.</td></tr>
</table>

<table>
<tr><td>Differentiation:</td><td><u>Auditory station</u>:
Supports: using fewer instruments, being able to see the instruments as the pattern is created, being provided a pattern, using ‘familiar’ sounds (I.e., clapping)
Extensions: students can close their eyes or have blindfolds on when listening to the pattern, having the same instrument that creates different pitches</td><td><u>Visual station</u>:
Supports: having cards with ideas available, using different manipulatives to create images, able to see original image that needs to be copied
Extensions: limit the amount of time the second student can look at the first student’s creation before repeating it, having a variety of objects to choose from, building in multi-directions, creating repeating and growing patterns, applying Transformation / Shape and Space curricular outcomes, creating table of values from created patterns</td><td><u>Kinesthetic station</u>:
Supports: having cards with ideas available, using only hands
Extension: creating subtle movements, adding in sounds and props</td></tr>
<tr><td>Modifications:</td><td colspan="3"><u>Movement- gross motor</u>: smaller movements, limb movements instead of whole body, seated options
<u>Movement- fine motor</u>: bigger objects for grasp
<u>Sensory</u>: noise cancelling headphones, awareness of volume, pitch, and frequency of sounds created
<u>Working memory</u>: picture prompts, reduced amount of pattern steps
<u>Overall Executive Function</u>: giving reminders, repeating instructions</td></tr>
<tr><td>Skill Development:</td><td colspan="3"><u>Executive Function</u>:
Working memory
Cognitive flexibility
Inhibitory control
Emotional control
Organization
Self-monitoring
Task initiation
<u>Social skills</u>:
Turn taking- linked to inhibition</td></tr>
</table>

	• Working with a group, including kindness, social language and body language • Accepting a loss Empathy building: • Playing with others Language development: • Oral language, including social language • Rapid naming

Important Terms

Prefrontal Cortex: front part of the brain where executive function skills are housed. This part does not mature until roughly 25 years of age.

Executive Function: is a set of soft skills that are taught and developed throughout childhood and adolescence. These skills allow for people to engage with others and the environment by dealing with multiple incoming messages and demands, much like an air traffic control centre at an airport. Executive function is essential for conflict resolution, regulating emotions, task completion, expected behaviours, and turn-taking. There are two theoretical divisions:

- **Hot:** aspects of executive function that are used in real world, emotional situations, such as interacting with peers, completing tasks, and earning prizes (Gibb & Kolb, 2018)
- **Cool:** aspects of executive function, specifically inhibitory control, working memory, and cognitive flexibility that are studied in laboratory research settings (Gibb & Kolb, 2018, p.309)

Working Memory: the "ability to hold information when completing a task, when encoding information, or when generating goals/plans in a sequential manner." (Gibb et al.). "The manipulation of information in [the] mind in the service of behavior." (Gibb & Kolb, 2018, p.311);
Examples include: remembering multiple directions, remembering numbers to transfer from a word problem to computation problem

Cognitive flexibility: "the ability to shift attention between task sets, attributes of a stimulus, responses, perspectives, or strategies" (Gibb & Kolb, 2018, p.316).
Examples include: being able to apply ideas from multiple subjects to a larger problem, being able to understand other's perspectives.

Inhibitory control: the suppression of attention and other responses to particular stimuli (e.g., distractors). (Gibb & Kolb, 2018, p.314); Ability to control impulses (inhibitory control) and to stop engaging in a behavior.
Examples include: being able to focus when others are talking, ignoring people in the hallway

Emotional Control: Ability to regulate emotional responses appropriately (Gibb et al.).
Examples include: responding appropriately during peer conflict, ability to accept a loss.

Organization of materials: Ability to put order in work, play, and storage spaces (e.g., desks, lockers, backpacks, and bedrooms).

Monitor: Ability to check work and to assess one's own performance; ability to keep track of the effect of one's own behavior on other people (Gibb et al.).

Rapid naming of objects and colors: Recognizing and identifying common items and basic colors (Gibb et al.).

Relevant Areas of the Brain

Play: "play behaviour is organized within the basal ganglia and cerebellum as well as cortical and subcortical regions dedicated to sensory, motor, and emotional behavior" (Cozolino, 2013, p.171).

Executive Function: prefrontal cortex (PFC); hot relies more on the ventral medial PFC (Gibb & Kolb, 2018)

- **Working memory:** frontal (superior frontal sulcus, bilateral) and parietal (intraparietal sulcus, bilateral) regions, as well as left occipital cortex, this specialization increases as children age (Gibb & Kolb, 2018, pg. 312)
- **Cognitive Flexibility**: uses the dorsolateral prefrontal cortex, left posterior parietal cortex, left premotor cortex, and the anterior cingulate cortex (Gibb & Kolb, 2018).
- **Inhibitory control**: in adults controlled by PFC. There are drastic changes in control networks from middle child onwards; in childhood the frontal-parietal network and cingulo-opercular network are bridged and separate in adulthood (Gibb & Kolb, 2018). Lack of inhibitory control can be characterized by a "reduced volume and activity in the anterior cingulate gyrus, inferior frontal gyrus (IFG), and the supramarginal gyrus" (Gibb & Kolb, 2018, p. 71)
- **Emotional control**: Some research demonstrates "failure of the medial frontal regions to undergo typical patterns of thinning over time … [this is] correlated with poorer emotional control and behavioral regulation" (Gibb & Kolb, 2018, p. 424).
- **Organization**: Some evidence suggesting decreased gray matter volume in frontal lobe, temporal lobe, and hippocampus results in decreased executive function skills (Gibb & Kolb, 2018). Ventromedial prefrontal region impacts decision-making in social and personal contexts (Gibb & Kolb, 2018)

Social skills:

- **Turn taking**: (see inhibitory control)
- **Working with a group**: (see empathy and playing with others)
- **Accepting a loss**: (see cognitive flexibility and inhibitory control)

Empathy building: Development of empathy and social understandings impacted by prefrontal and posterior superior temporal sulcus (pSTS) (Hashmi et al., 2020)

- **Playing with others**: Dorsal lateral prefrontal cortex (Gibb & Kolb, 2018)
- **Empathy**: Medial prefrontal region of the brain (Gibb & Kolb, 2018)

Language development: Left temporal lobe associated with language use and development (Gullick et al., 2016).

- Oral language: Broca's area (Kolb et al., 2019)

References

Bunge, S. A., & Zelazo, P. D. (2016). A brain-based account of the development of rule use in childhood. *Current Directions in Psychological Science: A Journal of the American Psychological Society, 15*(3), 118-121. doi:10.1111/j.0963-7214.2006.00419.x

Center on the Developing Child at Harvard University (2011). Building the brain's "air traffic control" system: How early experiences shape the development of executive function: working paper No.11. http://www.developingchild.harvard.edu

Cozolino, L. (2013). *The social neuroscience of education: Optimizing attachment and learning in the classroom (the Norton series on the social neuroscience of education)* (Illustrated ed.). New York, New York: W. W. Norton & Company.

Gibb, R., & Kolb, B. (Ed.) (2018). *The Neurobiology of Brain and Behavioural Development*. Academic Press.

Gibb, R., Piquette, N., Gonzalez, C. *Building brains and future: Enhanced curriculum.* University of Lethbridge.

Gullick, M. M., Demir-Lira, Ö. E., & Booth, J. R. (2016). Reading skill–fractional anisotropy relationships in visuospatial tracts diverge depending on socioeconomic status. *Developmental science*, *19*(4), 673-685.

Hashmi, S., Vanderwert, R. E., Price, H. A., & Gerson, S. A. (2020). Exploring the benefits of doll play through neuroscience. *Frontiers in Human Neuroscience*, *14*, 413-422.

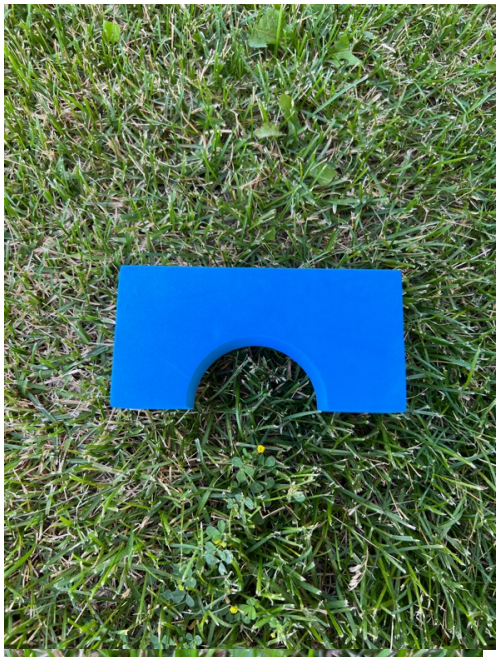
Kolb, B., Whishaw, I.Q., Teskey, G. C. (2019). *An introduction to brain and behaviour: Sixth Edition*. Worth Publishers: Macmillan Learning.

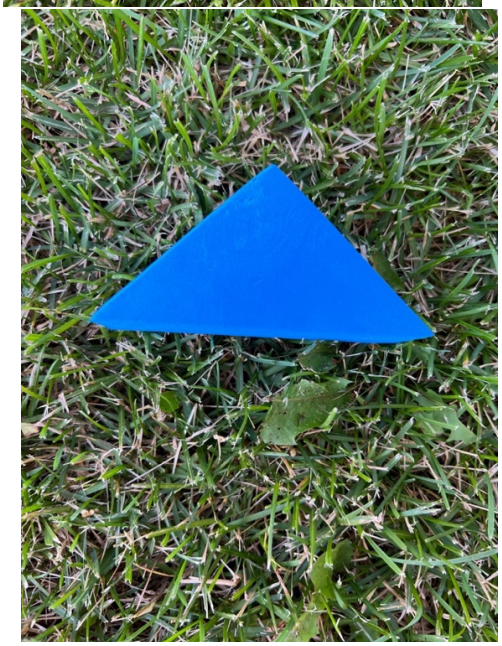
Zelazo, P. D. (2015). Executive function: Reflection, iterative reprocessing, complexity, and the developing brain. *Developmental Review, 38*, 55-68. doi:10.1016/j.dr.2015.07.001

Appendix A: Resources for Each Station

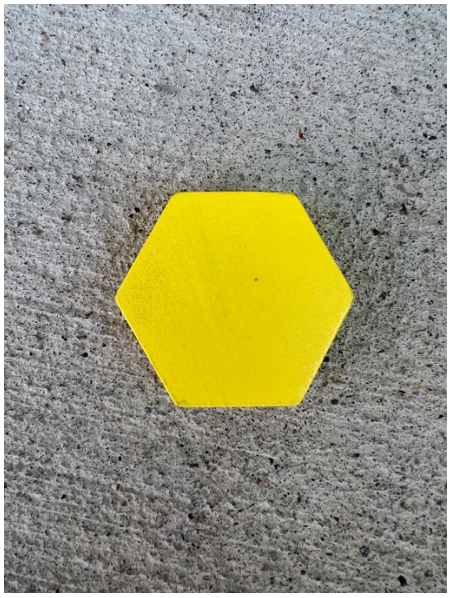
Auditory Station:
https://www.loom.com/share/c1c72e3d5e78489486ff03683ea0fd49
https://www.loom.com/share/41403d469633479cbaf7efe81e4ef552

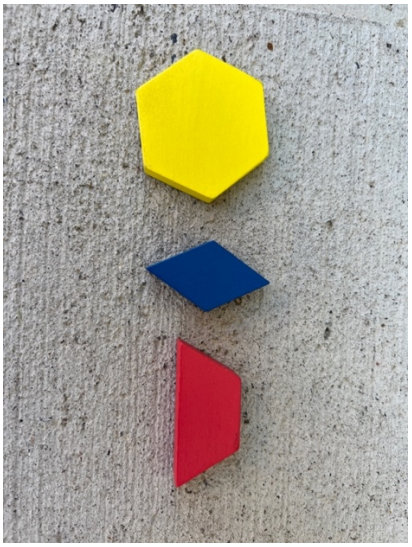
Foam Blocks Cards for Visual Station:

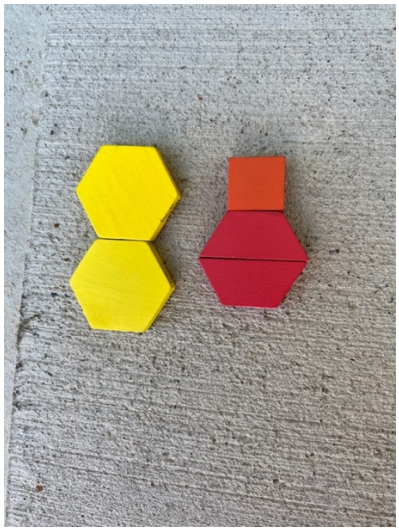


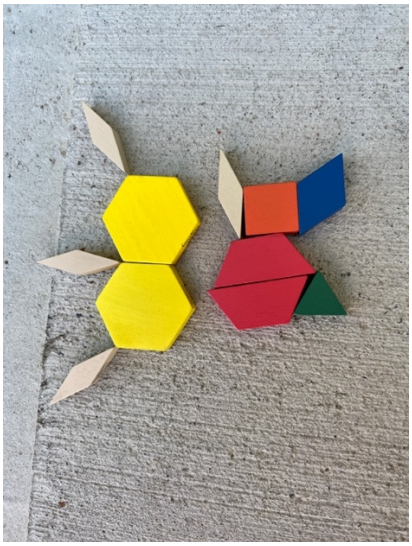


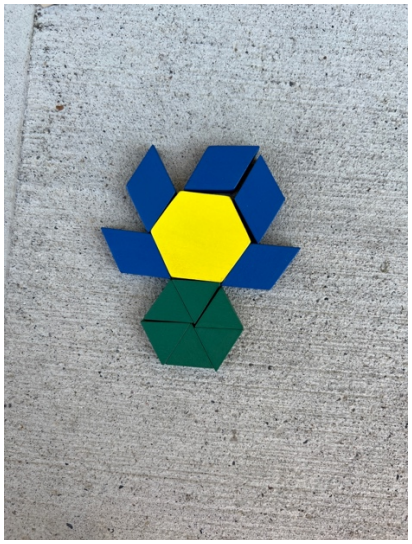
Wooden Block Cards for Visual Station:











Motor Cards for Kinesthetic Station:





The Drumming Circle

By Vanessa Barr and Jasmine Kinjo

Summer 2022 Neuro 5850

Category	Description
Overview	The Drumming Circle is a safe space for students to use repetition, music and relationships to heal. The Drumming Circle is led by a facilitator to teach some techniques of drumming, patterning and listening to create opportunities for all students to connect in creative, non verbal and verbal modes of expression.
Duration	Variable - Students can join or leave as needed
Materials	Hand Drums, Cloth Placemats or Sit Spots, The Drum Calls Softly by David Bouchard, Speaker with Music (optional)
Instructions	1. Have the students and facilitators sit in a circle 2. Give them a placemat to sit on if they do not want to sit on the grass 3. Set the drums just out of reach in front of the students and tell them not to touch them until told to 4. Once everyone has a drum in front of them, tell the students " when I say go, pick up the drum and bang it as much as you want." 5. As the energy starts to peter down, start a heartbeat rhythm pattern, eventually the students will join in. 6. Ask the students to put their drums down and sit on their hands to listen 7. Teach them the stopping pattern (a pattern of beats with a corresponding beat between the teacher and the student to indicate for the students to put the drum down) 8. Practice using the stopping pattern 9. Teach the students about the high beat (edge of the drum) and the low beat (center of the drum), allow practice time and use stopping pattern to gain their attention Below are 3 activity ideas to use with the drums 1. **Stories** - Listening to a book about drums to foster cultural awareness and appreciation. 2. **Follow the leader game** - Facilitator starts with some patterns for the students to copy but never stopping between allowing the students to figure out the new pattern through experience. Go around the circle allowing each student to pick a beat without stopping the beat. Facilitator will call names as it is time to switch.

	3. **Got Rhythm?** - Pick a favourite song to pick out the beat - Put on the speaker "We Will Rock You" and ask the students to copy the beat of the song. Put on "September" and ask the students to find the beat. Take requests. 4. **Extend the pattern** - The first person plays a beat, second person repeats and ads to it, continue around the circle, adding complexity by adding more beats
Differentiation	Supports - Keep the tempo slow enough that all can access - Only use the high beat or the low beat as needed rather than a combination - Ensure everyone knows or can represent the pattern before moving on Extension - When the student has their turn to be the leader, they can try a more complex pattern - Students can choose more complex songs to find the beat for and/or copy the pattern of the drum in the song
Modifications	Gross Motor - aiding in holding and handling drum/facilitated by caregiver as needed Working Memory - Lots of repetition built in to allow time to figure out new patterns
Skill Development	1. Channel cathartic release, or discharge strong feelings, safely through rhythm. 2. Non-verbal communication 3. Demonstrate improved gross motor skills, and coordination. 4. Improved Executive Function of working memory, flexibility and inhibition 5. Demonstrate improved social skills through a combined group effort activity. 6. Gain self-esteem and self-confidence by being a part of an artistic project. 7. Demonstrate improved frustration tolerance. 8. Develop personal expression through the creative art process.
Brain areas	Once the cochlear nerves deliver musical signals inside the skull, the brain goes to work. Researchers now realize music is not just processed in one part of the brain. Performing and listening to music gives big chunks of your brain a workout.

	Rhythm The belt and parabelt are located on the right side of the brain. They are mainly responsible for figuring out a song's rhythm. When creating rhythm by tapping toes or beating a drum, the ***motor cortex*** and ***cerebellum*** get involved. **Pitch and Tone** The recognition and understanding of pitch and tone are mainly handled by the ***auditory cortex***. This part of the brain also does a lot of the work to analyze a song's melody and harmony. Some research shows that the ***cerebellum*** and ***prefrontal cortex*** contribute, too. **Anticipation** Research shows our brains create expectations when listening to a song. For example, it would figure out if a beat is steady or the melody makes sense. But we especially like it when songs surprise us with smart, quirky changes. This analysis takes place in the brain's ***prefrontal cortex***. **Memory** People have an amazing ability to remember music. Chances are you can recognize your favorite song after hearing just a fragment. These memories are stored in the ***hippocampus***. **Performance** Musical acts like reading music, playing an instrument, and dancing fires up the ***cerebellum***, ***motor cortex***, ***sensory cortex***, and ***visual cortex***. **Emotion** Music has the power to trigger feelings in listeners. Three main areas of the brain are responsible for these emotional responses: ***nucleus accumbens***, ***amygdala***, and the ***cerebellum***. **Social** "Relationships are the key to opening a closed mind and rebuilding the brain" (Cozolino, 2013, p. 40) Mirror neurons link multiple brain regions: Motor components (premotor cortex, **motor cortex**, **cerebellum** and basal ganglia) Sensory components (superior temporal sulcus, somatosensory cortex, occipital lobe) and Emotional/Motivational Components (**amygdala**, insula and anterior cingulate) (Cozolino, 2013).
Integration of culture to drumming	- Music is celebrated in every human culture. - This activity creates space and opportunity to incorporate culture, cultural representation and possibly indigenous knowledge and teachings. - Teaching and learning about Indigenous culture can be one component of unlearning racism and building settler-Indigenous alliances.

	Possible cultural extensions:
	- Using literature to underscore that drumming is part of many many cultures.
	- Workshops or presentations by different cultural communities.
	  - Indigenous drummers
	  - Japanese drummers
	  - African drummers (available in French)
	Video: Drums from around the world

Integration of Storytelling and Literature to Drumming	● Increased engagement and creativity ● Storytelling using rhythm to identify characters and events ● Increased creativity when composing beats to corresponding characters of event ● The Drum, by Ken Wilson-Max ● The Drum Calls Softly, by David Bouchard

Executive Function Skills

Executive functions are the top-down processes that direct the regulation of thought, emotion and action (Perone et al, 2018). There are three underlying processes involved: **working memory** (ability to hold and use information in thoughts), **inhibitory control** (ability to focus despite distraction) and **cognitive flexibility** (ability to switch between thoughts) (Perone et al, 2018). These areas rely on the **Prefrontal Cortex** to operate (Perone et al, 2018).

Drumming supports several Executive Function skills. **Inhibit** to respect the oral instructions and **Shift** the behavior. In addition, **Working Memory** to remember the instructions so that you know what you are supposed to be doing, **Monitoring** what you are doing [looking around, hearing feedback], and **Emotional Control** related to achieving successful completion of the activity [or alternately controlling one's emotions if not successful]. As well, with drumming, students learn how to **initiate** (begin an activity or generate ideas) in a safe place while the repetition of the patterns and activities help the students to **plan and organize** their ideas and time.

Benefits for Developmental Disorders

ASD/intellectual/behavioural (Willemin et al, 2018):

- Three main areas of growth: gross motor/music/mindfulness
- Motor and Sensory Memory - multisensory inputs
- Physical and cognitive activities that enhanced neural plasticity and executive functioning
- Drumming Program showed a positive trend for social skills
- Improved participation and social relationships through reciprocity

- Intergenerational partner to work together with to achieve a greater level of performance

FASD and neurosequential model and music therapy: (Lambert-Jenkins, 2022)

- Applies to the child's state of arousal and ability to self-regulate
- Importance of integration of body and mind
- Ritualistic nature of the therapy and nonverbal accessibility
- Fosters hope, empowerment, and escape
- As group progressed, change from facilitator led to participant led
- Co-regulation, creativity, connection, and predictability

Developmental/Special Needs/Sensory Processing/Wheelchairs - (Percussion Play, 2018)

- Sensory integration - positive responses to stimuli as the fight or flight is rarely seen
- Holistically reduces fear and anxiety
- Easily accessible to wheelchair and simple movements

Benefits of infusing activity with cultural knowledge and teachings (Gebhard, 2018)

- When 'learning about the other' promotes an appreciation that the heritage, language, customs, and self-identification of the other are as significant, diverse, and fluid as one's own.
- Unlearning racism and building settler-Indigenous alliances.

References

Cozolino, L. (2013). The social neuroscience of education: Optimizing attachment and learning in the classroom (the Norton series on the social neuroscience of education) (Illustrated ed.). New York, New York: W. W. Norton & Company

Gebhard, A. (2018). 'Let's make a little drum': limitations and contradictory effects of cultural approaches in Indigenous education. *Race Ethnicity and Education*, *21*(6), 757-772.

Kolb, B., Whishaw, I.Q., Teskey, G. C. (2019). An introduction to brain and behaviour: Sixth Edition. Worth Publishers: Macmillan Learning.

Lambert-Jenkins, B. (2022). The Effectiveness of Music Therapy with Children Who Have Experienced Trauma Using the Neurosequential Model of Therapeutics (NMT): A Literature Review.

Percussion Play Ltd. (2018). Beating the Drum for Equality - The Benefits of Music for Those with Developmental Disabilities and SPecial Education Needs. Percussion Play. https://www.percussionplay.com/beating-the-drum-for-equality/

Perone, S., Almy, B., & Zelazo, P.. (2018). Toward an Understanding of the Neural Basis of Executive Function Development. In Gibb, R., & Kolb, B. (Ed.) The Neurobiology of Brain and Behavioural Development. Academic Press.

Your Brain on Music: The Sound System Between Your Ears. (July, 10, 2022). The Kennedy Centre 50. https://www.kennedy-center.org/education/resources-for-educators/classroom-resources/media-and-interactives/media/music/your-brain-on-music/your-brain-on-music/your-brain-on-music-the-sound-system-between-your-ears/

Willemin, T., Litchke, L. G., Liu, T., & Ekins, C. (2018). Social Emotional Effects of Drumtastic®: A Dyadic within-Group Drumming Pilot Program for Children with Autism Spectrum Disorder. *International Journal of Special Education*, *33*(1), 94-103.

Workman, S., & Damm, R. J. (2017). The positive effects of drumming on children with autism. *Percussive Notes*, *55*(3).

Name:	**Play Carnival Station: Adele Henderson and Suzanne Picard** **Sock Wrestling**
Overview:	Children will work with caregivers, siblings, or friends. While crawling or moving within a defined boundary, participants aim to steal the opposing player(s) socks. A structured and relatively safe opportunity for “Rough and Tumble Play”.
Duration:	5 Minutes
Materials:	• 1 or 2 socks per player • Boundary markers (pylons) OR • Boundary area (e.g. mats, carpet, tarp) • Visuals of game expectations (see attached)
Instructions:	1. Create a 3 metre by 3 metre boundary to mark the area of play (use a tarp, mats, carpet boundaries, or pylons). Expand size for older players or larger groups. 2. Divide players into two opposing teams (1 vs. 1, 2 vs. 2, etc.) 3. Explain the object of the game: to steal the opposing player's socks. 4. Review “Rules of the Game” with visuals: a. Socks partially on: the portion below the heel is loose/hanging. b. Take turns: only the two teams competing should be in the wrestling area. c. Stay low. No standing. (see "Optional” for mobility adaptations) d. “Stop” means STOP! - Everyone freezes if they hear this word. e. Smiles stop, play stops! - Monitor body language and facial expressions. f. Be safe (safe hands and bodies: no punching, no kicking) 5. Have opponents face each other on hands and knees. Adult says “GO!” a. Players crawl around, with safe contact at times, trying to steal their opponents’ socks. b. Adult monitors for safe play, smiles, and “STOP” moments. If using a timer, the adult signals “STOP” at the end of the round (1-2 mins to start). c. The first team to steal the opposing team’s socks, wins! OR the team with the most stolen socks at the end of a timed round wins.

Differentiation:	[1] Mobility options: For players who have difficulty crawling, engage in keep away: tuck socks into waistline, or place socks on the arm of the wheelchair or on the end of a pool noodle (position horizontally at waist). Each competitor must keep moving and circle the wrestling ring twice without getting their sock stolen. An opponent circles in the opposite direction and attempts to steal the sock as they pass. Safe contact should still be initiated at meet-up points. 3] Non-competitive option: using a pillow or soft object, caregiver provides appropriate resistance as the child attempts to roll towards the adult, into the centre of the ring. Alternatively, the child could attempt to crawl away from the adult while the adult provides appropriate resistance, holding the child back. [2] Wrestler round-up (for group turn-taking, signal warm up, or 'rough and tumble' speaking/moving without contact): before each round, students circle the outside of the ring, using their best wrestler's strut. On "Stop!", players freeze in a wrestler-superhero pose. Additional option: the wrestler who freezes nearest the clock shares an "we are" strength statement, and the other wrestlers mirror their pose and saying. 4] Cool down: adult guides competitors in mindful breathing (ex. 5-4-3-2-1 sensory naming: adult prompts child "what are 5 things you see, here and now...4 things you can touch... 3 things you can hear...2 things you can smell...1 thing you can taste.") 5] Additional community-building: (a) competitors make "CHAMP" belts (ribbons, with decoration) when they leave the ring. See "SHARED PROJECT" BBF activity for details). Kids can choose between following a visual exemplar, working with a partner to create matching belts, or free play with belt-making supplies. (b) kids add to a "Wrestler's Wall of Fame" using their choice of manipulatives (pens, stickers, pre-made stars).
Skill Development:	EF: **Working Memory** to remember wrestling goal, instructions, and limits. **Inhibit** to respect "Stop", follow safety rules. **Initiate** strategies to respond to fellow players' moves. **Emotional Control** through setbacks [losing a sock] and achieving success [stealing a sock, dodging a steal, or winning the round]. **Monitor** personal movement [body position, forcefulness], facial expressions [self and others]. EL: **Concepts about print** – decoding connections between instructions and signs. **Oral Language** – listening comprehension for directions and during the match, monitoring signals/tone from others.

Important Terms

Affective processes: the arousal, processing, and behaviours associated with emotions, involving internal and external processes (Panksepp, 1998; Gibb & Kolb, 2018; Gibb 2021).
Challenge-by-choice: an approach to play that allows participants multiple entry and exit points, so that they can stretch at their own pace through levels of play (Gibb & Pope, 2021).
Executive Function skills: a set of processes engaged in problem-solving, attention, and prioritizing tasks that involve three main domains: working memory, cognitive flexibility, and

behavioural inhibition. Executive function is the “air-traffic control” system of the brain (Phillips, 2012).

Rough-and-tumble play (RTP): RTP is a primitive form of play, dating back at least one hundred and sixty million years (Pankseep, 1998). RTP, or play fighting, is associated with the development of physical coordination, strength, agility, spatial awareness, risk management, emotional management, social negotiation, cooperation, and moral systems (Kelley & Kelley, 2017). RTP differs from aggression in that it is engaged in voluntarily, and associated with positive affect (Burghardt, 2005).

Regulation and Inhibition: the ability to control behaviour by monitoring emotions, connecting causes with consequences, and delaying responses or rewards. Regulation involves individual and social processes.

Social Learning: Developing Theory of Mind (ToM); Understanding of oneself; Self-Regulation; Understanding of the social world (Kolb, Whishaw & Teskey, 2019) and creating a shared social story through learning and play (Cozolino, 2013).

Working Memory: a cognitive model explaining the ability to hold limited amounts of information in mind, ready to use, for short periods of time (Gibb, R. 2020; Zelazo et al., 2016), and how this ability connects with other memory systems.

Relevant Areas of the Brain

Skill	System/Location in the Brain	Connections to the Game
Executive Function		
Working Memory	*Frontal cortex (mFG; frontal aslant tract), Prefrontal cortex, Anterior cingulate cortex, Interior Frontal Gyrus* (Broca's area) - holding on to sensory, motor, and language information	- chunking stages at each station - attending to/rehearsing directions - remembering affective cues and locations of visual prompts
Inhibition	*Prefrontal Cortex (mPFC):* -regulatory control over amygdala; connections refined through RTP (BDNF increased) *Frontal Cortex (premotor cortex):* -integrates sensory cues to plan or inhibit movement	- monitoring emotional affect and body movement of self and others - moderating frustration and elation - turn-taking at each station - responding to "stop" signals
Shift	*Prefrontal cortex/Motor Cortex:* -involved when sequencing and switching between planned movements	- shifting strategies for sock-stealing -choosing/moving between stations
Emotional Control	*Amygdala, Cingulate Cortex* and *Prefrontal Cortex:* involved in affective signalling, reward system, limbic system, and stress responses	- identifying differences between RT play and aggression - moderating frustration and elation
Initiate	*Prefrontal cortex/Motor Cortex:* -planning and decisions about next steps/movements	- choosing wrestling strategies and adaptations based on other players - choosing Challenge-by-choice entry and exit points.
Plan/ Organize	*Prefrontal Cortex/Motor Cortex:* -Primary motor cortex involved in each intentional move a child makes; sends signals to spinal cord to initiate movement	- set goals and organize movements to engage in play options
Monitor	*Motor Cortex:* -mirror neurons in the premotor cortex help the child to imitate and understand others actions and intent; initiates co-regulation *Limbic System:* -the reward system of the brain, including the release of oxytocin and dopamine	-observing opponent's actions -copying other's sounds/ movements during wrestler round-up -co-regulation with supportive adults (release of dopamine and oxytocin when playing with others)

Emergent Literacy Skills		
Oral Language	Frontal lobe (IFG/Broca's Area) and left hemisphere temporal lobe (Wernicke's area)	- processing spoken directions and connecting them to play (all stations) - community-building through shared self-expression (Wrestler Round Up - "we are" statements)
Writing/ Drawing	*Visual Cortex*; *Wernicke's area* - connecting symbols to meaning and/or language	- multiple mode signing of Wrestler Wall of Fame.
Concepts About Print	*Left hemisphere temporal lobe (Wernicke's area)* - connecting symbols to meaning	- Affect signs for play vs. Aggression - multiple mode signing of Wrestler Wall of Fame.
Additional Areas of Development		
Proprioception	*Parietal Cortex:* -awareness of the body's position in space is processed in the somatosensory association cortex -plays an important role in self-regulation including coordination, posture, focus	-proprioceptive input provided by resistance and impact of RTP

References

Burghardt, G.M. (2005). The genesis of animal play. Cambridge, MA: The MIT Press.

Cozolino, L. (2013). *The social neuroscience of education: Optimizing attachment and learning in the classroom*. New York, New York: W. W. Norton & Company.

Gibb, R., & Kolb, B. (Ed.) (2018). *The Neurobiology of Brain and Behavioural Developmen*t. Academic Press.

Gibb, R. and Pope, F. (2021 July 7). Chapter 12 and Challenge by Choice [Lecture Notes]. *NEUR 5850: Emotions, Learning and the Brain*. Lethbridge, Canada.

Gibb, R. (2020 July 20). Chapter 14: Memory [Lecture Notes]. *NEUR 5850: Introduction to Behavioural Neuroscience*. Lethbridge, Canada.

Gibb, R. (2021 July 9-10). Chapter 4: The Human Social Brain [Lecture Notes]. *NEUR 5850: Introduction to Behavioural Neuroscience*. Lethbridge, Canada.

Kelley, R., & Kelley, B. (2017). Just wrestle: How we evolved through rough and tumble play. *Journal of Evolution and Health*, *2*(3).

Kolb, B., Whishaw, I.Q., Teskey, G. C. (2019). *An introduction to brain and behaviour*: *Sixth Edition*. Worth Publishers: Macmillan Learning.

Panksepp, J. (1998). *Affective neuroscience: The foundations of human and animal emotions*. Oxford University Press.

Phillips, D. (2012). Interventions in executive functioning. *Alberta Family Wellness and the Palix Foundation's 2012 Accelerating Innovation Symposium*. Calgary, Canada.

Zelazo, P. D., Blair, C. B., & Willoughby, M. T. (2016). Executive Function: Implications for Education. NCER 2017-2000. *National Center for Education Research*.

Play Carnival: Jason Wutzke, and Josh Boettcher
Neuro 5850 Summer 2022

Name:	**Pirate Ball**
Overview	This is a large group activity that combines aspects of games like tag and capture the flag. This team-based activity requires players to work together to acquire their specific treasure while preventing other groups from taking theirs.
Duration	10-15 minutes for single game
Materials	- X4 each of 4 types of balls/objects (Treasure), - 4 mats (Dungeons) - rope or pylons (means of sectioning off boundaries) - 4 hula-hoops (treasure chests) - Pinnies (means of identifying team members) - However, much of this equipment is not absolutely necessary for this game to be successful.
Instructions	**<u>Set Up</u>** -Divide the play area into four equal quadrants. (tape, chalk, cones and such, will also work fine). In the far corner of each quadrant you will build a base. Each base consists of a -mat place diagonally across the back corner. -Behind the mat (inside the small triangle created by the mat placement) place a hula-hoop. -Inside each hula-hoop should be 1 of each type of object being used **<u>Play:</u>** -Divide the group into four equal teams and have each team put on their designated color of flag or pinnies. -Each player must begin the game from his or her own home base. -Each team will be given a name that is representative of their particular ball/object. -The object of the game is for each team to collect all of their designated balls/objects from the opposing teams. -**The first team to have gathered all four of their own balls will be declared the winner of that round.**

	<u>Rules of this game:</u> -Once a player enters an opposing team's quadrant (pirate ship), he or she is susceptible to being tagged. -If you are tagged, go to their dungeon (mat). -If a player successfully makes it into an opposing team's vault (triangle of floor behind the mat) they must rescue one of his/her teammates (to rescue; student must escort his/her teammate, by the hand, all the way back to their own quadrant). *-In all variations of this game, rescued students and their escort get a free walk back to their quadrant as long as the hand joins them.* -If a player makes it to the opposing team's vault and there are no prisoners from his team to rescue, then he may steal only the treasure that represents his team. -A player that retrieves treasure can be tagged once they have left the dungeon/treasure area until they make it back to their zone
Alternative Game Rules	**<u>3 teams</u>** ● If there is a smaller group, you can run the game with three teams to keep the appropriate size of teams ○ Just remove one type of the four objects, and one each for the other objects ○ Modify game space accordingly **<u>Alternative Play</u>** ● **Collect one of each item to win** ○ Game play would begin with each team having all of one type of treasure in their chest ● **Teams can steal any treasure of their choosing** ○ Adds difficulty and strategy as now teams can coordinate with or against each other ● **Treasure-focused return** ○ Increase the game's difficulty and gross-motor development by having players return the ball to their zone using movement appropriate to the ball (e.g. dribbling for basketballs) ● **Zone-based movement** ○ Increase the game's difficulty and gross-motor development by having each zone require a different kind of movement by players (e.g. hopping in zone 1, crawling in zone 2, etc.)

Adaptive Play Modes and Modifications	**<u>Movement: Gross Motor:</u>** ● Alternative tagging ○ Players with limited mobility could tag in a different manner, for example, to use a pool noodle to increase reach and range ● Jail Exempt Players ○ Players with mobility concerns can be considered exempt from going to the dungeon. They would only be required to return to their team's boundary ● Returning stolen treasure ○ Players with mobility concerns that would prevent them from moving while carrying treasure while moving, may be granted free passage back to their area **<u>Sensory:</u>** ● Alternative "tagging" ○ Using Velcro belt flags, organizers can accommodate players whose touch sensitivities should preclude tagging
Skill Development	**Executive Functions:** ● Emotional Control: As a collaborative competition, this game requires that children employ socially appropriate control over emotions. These controls include, at least, graceful winning, coping with disappointment and losing, encouraging teammates, and understanding and tolerating fairness when rules may be modified for others. ● Inhibit: This game requires that children exert inhibitory control by resisting the urge to leave "prison" until freed or to tag ineligible targets ● Monitor: This game requires that children exert attentional control to perceive and monitor the activity of their own teammates and the members of other teams independently and in response to their own acts. ● Plan/Organize: This game requires that children strategize with a team to meet multiple demands at once and to coordinate a set of steps that will lead to the team's goal. ● Shift: This game requires that children use cognitive flexibility to shift attention from one kind of task to another in real time or respond to game developments and apply new strategies; for example, switching from collecting objects to freeing teammates when your team's numbers are down because they are in "prison", or moving to tag an opponent to defend rather than collecting another object when your team is about to lose. ● Working Memory: This game requires that children keep in mind multiple rules as the circumstances of the game shift as part of

	orienting the team toward the goal. **Emergent Literacy:** ● Oral language, including comprehending instruction and using social language to strategize as the game proceeds. **Visual Processing System** ● Players must be able to process visual information in order identify objects of interest, analyze distances between targets and use their visual guidance to help ensure accurate motor co-ordination (Tag). **Gross Motor Coordination** ● The starting and stopping aspect of tag games helps promote development of proprioception, vestibular input, motor planning, body awareness, depth perception, balance, coordination, postural control.

Important Terms and Relevant Areas of the Brain

Cognitive flexibility: "The ability to shift attention between task sets, attributes of a stimulus, responses, perspectives, or strategies" (Gibb & Kolb, 2018, p.316).
Brain Areas: uses the dorsolateral prefrontal cortex, left posterior parietal cortex, left premotor cortex, and the anterior cingulate cortex (Gibb & Kolb, 2018).

Emotional Control: The ability to regulate emotional responses appropriately (Gibb et al.).
Brain Areas: Research tends to show that emotional behavior correlates with the development of the medial frontal regions (Gibb & Kolb, 2018, p. 424).

Executive Function: A set of "soft" skills that are taught and developed throughout childhood and adolescence. These skills allow for people to engage with others and the environment by dealing with multiple incoming messages and demands. Executive function is essential for conflict resolution, regulating emotions, task completion, expected behaviours, and turn-taking.
There are two theoretical divisions:

• **Hot:** aspects of executive function that are used in real world, emotional situations, such as interacting with peers, completing tasks, and earning prizes
(Gibb & Kolb, 2018)

• **Cool:** aspects of executive function, specifically inhibitory control, working memory, and cognitive flexibility that are studied in laboratory research settings (Gibb & Kolb, 2018, p.309)
Brain Areas: prefrontal cortex (PFC); hot relies more on the ventral medial PFC (Gibb & Kolb, 2018)

Gross Motor Coordination: Complex way in which the brain takes in sensory information and plans, coordinates, and executes movement. Often a result of preprogrammed motor sequences by the brain to move as a unit (Kolb et al., 2019).
Brain Areas: Although this complex process involves many parts and subparts of the brain and nervous system. The primary parts of the brain would be the motor cortex and sensory cortex (Kolb et al., 2019).

Inhibitory Control: the suppression of attention and other responses to particular stimuli (e.g., distractors). (Gibb & Kolb, 2018, p.314); the ability to control impulses (inhibitory control) and to stop engaging in a behavior.
Brain Areas: in adults controlled by PFC. There are drastic changes in control networks from middle child onwards; in childhood the frontal-parietal network and cingulo-opercular network are bridged and separate in adulthood (Gibb & Kolb, 2018).

Language development: The process in which we learn to communicate and understand language.
Brain Areas: angular gyrus in the parietal lobe, Wernicke's area (comprising mainly the top rear portion of the temporal lobe), insular cortex, basal ganglia and cerebellum (Pinel, 2008).

- Wernicke's area: Language comprehension
- Angular Gyrus: Translates written words into auditory code
- Broca's area: Controls motor programs for speech production

Monitor: The ability to check work and to assess one's own performance; the ability to keep
track of the effect of one's own behavior on other people (Gibb et al.).

Brain Areas:

- Areas of the brain that are believed to be most associated with self-reflection and assessment are the posterior cingulate, and medial prefrontal cortex (mPFC), together they are known as the cortical midline structures (Moran et al., 2013).
- Playing with others: Dorsal lateral prefrontal cortex (Gibb & Kolb, 2018)
- Empathy: Medial prefrontal region of the brain (Gibb & Kolb, 2018)

Working Memory: the "ability to hold information when completing a task, when encoding information, or when generating goals/plans in a sequential manner." (Gibb et al.). "The manipulation of information in [the] mind in the service of behavior." (Gibb & Kolb, 2018, p.311);
Brain Areas: frontal (superior frontal sulcus, bilateral) and parietal (intraparietal sulcus, bilateral) regions, as well as left occipital cortex, (Gibb & Kolb, 2018, pg. 312).

Visual Processing System: The system at which the brain recieves and processes visual stimulation
Brain Areas: Retina→LGNd→Primary visual cortex→(Dorsal stream)→Posterior parietal cortex →(Ventral stream)→Infero-temporal cortex
(Gibb & Kolb, 2018, p.214)

References

Gibb, R., & Kolb, B. (Ed.) (2018). The Neurobiology of Brain and Behavioural Development. Academic Press. Gibb, R., Piquette, N., Gonzalez, C. Building brains and future: Enhanced curriculum. University of Lethbridge.

J., P. J. Pinel. (2008). *Colorful introduction to the anatomy of the human brain* (2nd ed.). Allyn & Bacon.

Kolb, B., Whishaw, I.Q., Teskey, G. C. (2019). An introduction to brain and behaviour: Sixth Edition. Worth Publishers: Macmillan Learning.

Moran, J. M., Kelley, W. M., & Heatherton, T. F. (2013). What can the organization of the brain's default mode network tell us about self-knowledge? *Frontiers in Human Neuroscience*, *7*. https://doi.org/10.3389/fnhum.2013.00391

Creationary

Activity Description:

Creationary* uses the concept of Pictionary, but replaces the drawing component with building blocks. In this activity, builders will use prompts to create a block model as well as interpret the block models created by others. This game will engage builders in a structured play activity that promotes development of aspects of executive functioning, notably *initiation, planning,* and *organization*. *Shifting* and *emotional regulation* may also be supported through the use of this play activity. These skills are further discussed below in the ***Skill Development*** section. In addition to promoting the development of executive function, this game also encourages students to engage in fine motor development through the manipulation of blocks. This game can be played with any number of students, but to help promote participation in round 2, groups of 3 or 4 will be best. If time is limited, this activity can be broken down into 5-minute increments by doing one build at a time rather than progressing through the directions all at once. If completed in groups of 4, the entire game should take roughly 30 minutes.

*Creationary was a pre-packaged game created by Lego in 2010 that has since been discontinued. This activity, though sharing the name, is not a re-creation of the Lego game but is based on the same concept of combining Pictionary and Lego.

Directions:

1. A tub of Lego is placed in the center, the children are asked to sit, stand, lay, or kneel around it. This tub should be wide and shallow so that the Lego is spread out rather than piled up. This can be done on the floor or with the use of a table depending on the children participating. This activity can also be easily taken outside so builders also get some fresh air.
2. ***Round 1:*** Ask one child to pick a prompt from the pile. Everyone will then begin building that thing. Depending on time constraints you may want to set a timer at this point.
3. Once the timer goes off, or everyone has completed their model, facilitate a discussion on how these things are similar and how they are different. Children can talk about their planning process while considering the diverse end results.
4. Time permitting, continue round 1 until everyone has had a chance to pick a prompt.
5. ***Round 2:*** Each person will pick a prompt, keeping it to themselves. They will then begin to build their model. Again, a timer may be used here. If there is difficulty in guessing what the model is, encourage the builder to start describing, in general terms, what they are doing.
6. Time permitting, continue round 2 to allow students opportunity to build a variety of models.

Adaptations to Game Play:

1. Varied Complexity
    - When compiling prompts, it is important to integrate levels of varied complexity. Allowing builders the opportunity to "pass" on a prompt and pick a new one provides the ability to self-advocate. This works both when they feel the prompt is too challenging, and when they feel it is not challenging enough. As the facilitator it is important to help builders find a balance between challenging themselves while still feeling that success is attainable.
2. Visual Prompts
    - In addition to the use of written prompts, visual prompts that show either the item itself or a Lego model of the item can provide the builders with a point of reference to help them with initiation.
3. Block Size / Alternate Materials
    - To aid builders who are still developing gross and fine motor skills, larger blocks can be used. These blocks are easier to grab and manipulate while completing the same activity, allowing these builders to feel success. It is important to note that some prompts may be more difficult to build with larger blocks compared to smaller ones and that should be considered when making this adaptation. The use of alternative materials such as Playdoh may be easier for students with limited fine and gross motor function.
4. Prebuilt Models
    - Providing students with a pre-built Lego model for them to emulate in their building as an additional visual input to scaffold the building process.
5. Pre-sorted building packs
    - A tray of mixed blocks may be overwhelming for some students. To help focus their attention on building rather than searching and sorting, pre-packaged sets can be created that contain only the necessary blocks.

Sample Building Prompts:

This list has been included as a guide and showcases a range of levels of difficulty. Encouraging builders to come up with the prompts themselves adds another layer of depth to this activity and allows them to contribute their own interests and pre-existing knowledge.

• Bridge • Window • Stairs • Table • Helicopter	• Boat • Tree • Airplane • Hammer • Windmill	• Robot • Vehicle • Turtle • Birdhouse • Bird

Skill Development:

In general terms, ***executive function*** can be divided into three primary categories; working memory, cognitive flexibility, and emotional regulation (Gibb & Kolb, 2018). Each of these

categories can be further divided to represent a wide array of skills. Due to the individualized nature of play, this activity could encourage varied skill development among different participants, including the development of fine motor and social skills. For further information on executive function, play, and brain development that are directed towards educators and families see the ***Additional Resources*** section below.

Four ***executive function*** skills can be considered through engagement with this activity:

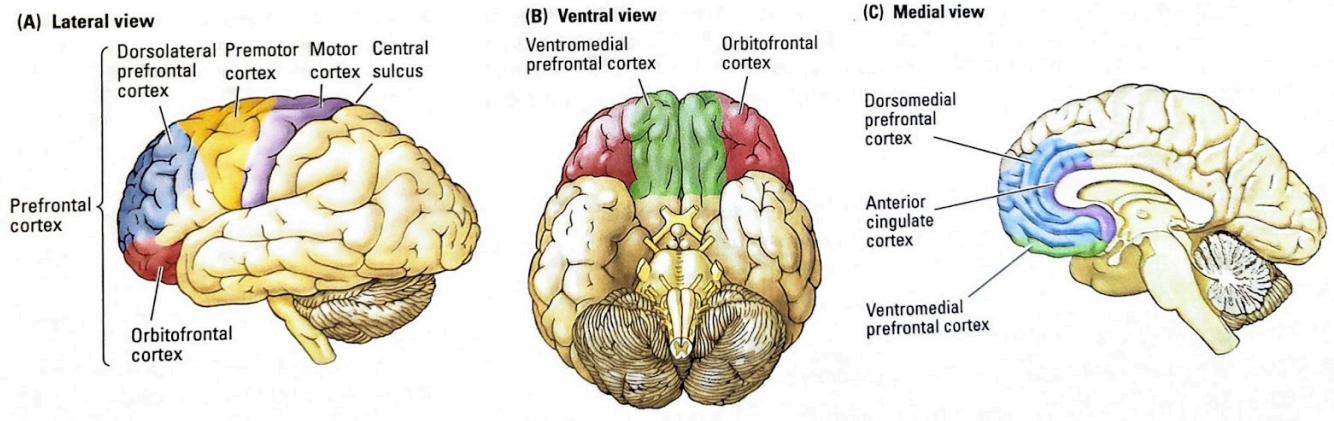
Initiation
First, builders will need to ***initiate*** the process by generating a strategy of how to represent the prompt through the use of blocks.

Planning and Organizing
Following ***initiation***, builders need to ***plan and organize*** by anticipating the steps needed and the physical pieces required to attain the finished product.

Shifting
Builders will need to ***shift*** behaviors as they alternate between creating and guessing and adapt to time limits if utilized.

Emotional Control
Emotional control may become a component of round 2 of this activity as builders engage in competition and experience both successful and unsuccessful guessing as their peers are building.

Associated Brain Architecture:
Throughout development, there are two primary times where brain development is characterized by a high degree of neural plasticity; early childhood and adolescence. During these times, the brain is physically altering the pathways that contribute to all aspects of cognition and learning, executive function included. Play is often considered an integral component of education during that first period of neural plasticity, however, during the second period time is often directed towards academic rigor and acquisition of knowledge. This dichotomy separating play and academic rigor is an important discussion in itself, but it is important for practicing educators to be mindful of the impact that play can have on brain development during the adolescent years as



well. Play engages many areas of the brain and those associated with executive function are briefly summarized below. A figure has been included as a reference to some of the structures introduced. (Kolb et al., 2019, p. 426)

> ***Initiating:***
> Initiating, like most aspects of executive functioning, begins in the prefrontal cortex. The various sensory inputs of the game (seeing the blocks, reading the prompt, hearing the instructions) are integrated within the prefrontal cortex. It is at this point that the prefrontal cortex will begin forming a strategy for success. Additionally, as the builder becomes aware of the activity and the environmental context, the orbitofrontal cortex is also seeking to adapt behaviour to suit the environmental context (Kolb et al., 2019). In this case, the orbitofrontal cortex is preparing the builder for the playful activity.
>
> ***Planning and Organizing:***
> Planning to collect the necessary blocks occurs in the prefrontal cortex, with the ventromedial prefrontal cortex playing a role in task-based decision making (Gibb & Kolb, 2018). As this process progresses, builders will rely on connections to additional areas of the brain to carry out a task. In this building task, the organizing occurring within the brain will also be externalized when the prefrontal cortex communicates with the premotor cortex where movement becomes coordinated, in turn communicating with the motor cortex which will activate motor pathways and allow the builder to collect and combine the necessary pieces (Kolb et al., 2019, p. 356).
>
> ***Shifting:***
> Shifting is one of the components of cognitive flexibility which utilizes both the dorsolateral prefrontal cortex and the anterior cingulate cortex (Gibb & Kolb, 2018). The dorsolateral prefrontal cortex draws upon memory to select behaviour and movement that allows for switching between tasks (Kolb et al., 2019). The anterior cingulate cortex provides a link between cognition and emotion (Kolb et al., 2019), indicating an important area for individuals who struggle with transitioning between tasks.
>
> ***Emotional Control:***
> Emotion is widespread throughout various parts of the brain including the prefrontal cortex, particularly within the ventromedial prefrontal cortex and the orbitofrontal cortex. The orbitofrontal cortex not only helps to interpret and respond to sensory input from the environment (see ***Initiating***), but it also contains connections to the amygdala and hypothalamus (Kolb et al., 2019), two key structures in emotional response. As discussed, the ventromedial prefrontal cortex is linked to decision making (see ***Planning and Organizing)***, and those decisions may result in emotional (dis)regulation.

Through the use of a play-based activity such as this one, various parts of the prefrontal cortex are engaged in hopes that participants are developing and refining executive function.

Additional Resources:

Building Brains Together: Connecting the science of brain development to the importance of play. Here you will find various resources including free online courses, videos, and game ideas as well as current research.

Project Zero: Associated with the Harvard Graduate School of Education, Project Zero provides educators and families with a substantial array of resources. The website is well organized around grade levels and educational topics and provides easy to implement playful learning activities.

The Brain Story is a multi-module online training course provided by Alberta Family Wellness that covers a wide variety of brain-based developmental topics. Though this resource requires a significant time commitment, it can be completed at your own pace and I highly recommend it to any educator or parent interested in learning about child development.

Mental Health Literacy (formally teenmentalhealth.org) is an Alberta resource connected to the Canadian Mental Health Association. In addition to the various information on mental health targeted towards students, parents, and educators, the toolbox section of the website provides both an elementary and a high school curriculum guide to teaching mental health literacy in an engaging and interactive way that promotes many aspects of play and builds executive function.

Child Mind Institute provides insight into both typical and atypical development through various resources. This is a potential source for PD resources for educators as they offer a wide array of school and community based training programs.

References

Gibb, R., & Kolb, B. (Ed.) (2018). *The Neurobiology of Brain and Behavioural Development*.

Academic Press.

Kolb, B., Whishaw, I. Q. & Teskey, G. C. (2019) *An introduction to brain and behavior* (6th

ed.). Worth Publishers